Scientific and Technical Aerospace Reports

A SEMIMONTHLY ABSTRACT JOURNAL WITH INDEXES

Table 3.

LIBRARY
SCHOOL OF ENGINEERING
DUKE UNIVERSITY

JULY 8, 1971

VOLUME 9 • NUMBER 13

N71-24351—N71-25600

PUBLIC DOCUMENTS

JUL 20 1971

Perkins Library
Duke University

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PURCHASE OF *STAR*

The semimonthly issues and the cumulative index are available postpaid on subscription and in single copy from the Superintendent of Documents, United States Government Printing Office, Washington, D. C., 20402, United States of America.

Semimonthly issues...

Annual subscription rate: $54, domestic; $68.25, foreign. Price per single copy: $2.25, domestic; 25% extra for foreign mailing.

Cumulative index issues...

Annual subscription rate: $30, domestic; $35, foreign. Price per single copy varies according to the number of pages.

Domestic subscription rates...

Apply to the United States, Canada, Mexico, and all Central and South American countries, except as noted below.

Foreign subscription rates...

Apply to Argentina, Brazil, French Guiana, Guyana, Surinam, British Honduras, and all other countries throughout the world.

Payment should be by check, money order, or document coupons, and must accompany order. Remittances from foreign countries should be made by international money order, or draft on an American bank, payable to the Superintendent of Documents, or by UNESCO book coupons.

PUBLISHED BY:
UNITED STATES GOVERNMENT
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SCIENTIFIC AND TECHNICAL INFORMATION OFFICE
Scientific and Technical Aerospace Reports, Volume 9, is prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Informatics Tisco, Inc.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget March 11, 1971.

Eng'g.
z629.13
U58TA
v.9
1971
no. 13-18

INTRODUCTION

A COMPREHENSIVE INFORMATION SERVICE

The National Aeronautics and Space Administration makes the results of worldwide research and development activities in aeronautics, space, and supporting disciplines promptly available to participants in its programs. NASA's scientific and technical information system now contains nearly a million documents, which are abstracted, indexed, and obtainable through retrieval and dissemination services. These services, which include this abstract journal, *Scientific and Technical Aerospace Reports (STAR)*, are described fully in a bulletin, *The NASA Scientific and Technical Information System . . . and How to Use It*, available at no charge from the NASA Scientific and Technical Information Facility, P.O. Box 33, College Park, Maryland 20740.

STAR—A REPORT ABSTRACTING SERVICE

STAR is a comprehensive abstracting and indexing journal covering current worldwide *report* literature on the science and technology of space and aeronautics. Publications abstracted in *STAR* include scientific and technical reports issued by NASA and its contractors, other U.S. Government agencies, and corporations, universities, and research organizations throughout the world. Pertinent theses, NASA-owned patents and patent applications, translations, and other separate documents are also abstracted. Citations and abstracts in *STAR* are grouped in 34 subject categories. Six indexes are included in each issue: subject, personal author, corporate source, contract number, report/accession number, and accession/report number. Cumulative index volumes are published semiannually and annually.

STAR, which is issued on the 8th and 23rd of each month, is available to the public on subscription from the Superintendent of Documents, U.S. Government Printing Office, as noted on the inside cover. *STAR* is sent without charge to:

1. NASA Offices, Centers, contractors, subcontractors, grantees, and consultants;
2. Other U.S. Government agencies and their contractors;
3. Libraries in the United States that have arrangements with NASA to maintain collections of NASA documents for public use;
4. Other organizations in the United States having a need for NASA documents in work related to the aerospace program; and
5. Foreign government or academic organizations that have established appropriate reciprocal arrangements with NASA.

Those eligible to receive *STAR* without charge should address their requests to the NASA Scientific and Technical Information Facility.

ABSTRACTS OF NON-REPORT LITERATURE

By arrangement between NASA and the American Institute of Aeronautics and Astronautics, the AIAA publication *International Aerospace Abstracts (IAA)* provides parallel coverage of scientific and trade journals, books, and conference papers in the same subject areas as the reports abstracted in *STAR*. *STAR* and *IAA* are categorized and abstracted in basically identical ways, and documents in both are indexed by terms from the *NASA Thesaurus*. Both journals appear twice monthly. *IAA* is issued on the 1st and 15th of each month.

IAA is available on subscription from the American Institute of Aeronautics and Astronautics, Technical Information Service, 750 Third Avenue, New York, New York, 10017, at the following annual rates:

Semimonthly issues: United States and Possessions, $110 postpaid, foreign countries, $125 postpaid.

Cumulated index volumes: United States and possessions, $75 postpaid; foreign countries, $90 postpaid.

PUBLIC AVAILABILITY OF DOCUMENTS ANNOUNCED IN STAR

The source of documents announced in *STAR* varies, depending upon the organization which has originated and/or issued the document and the form (paper copy or microfiche[1]) in which the document can be provided. Documents produced by NASA, including its contractor and grantee documents, are identified by an asterisk (*) following the accession number (e.g., N71-10748*). Most of the NASA documents and many of the documents issued by other organizations have had microfiche copies produced. Those documents that can be obtained from some source on microfiche are indicated in *STAR* by the # symbol following the NASA accession number. All documents for which microfiche can be obtained are also available as facsimile or, for some, as printed copies.

Documents that can not be microfiched but for which one-to-one facsimile can be provided are indicated by a plus (+) instead of the # sign. Documents for which neither the + nor # symbol is shown, and for which no availability other than the issuing activity is given, may present unusual problems of reproducibility. The originator of such a document should be consulted as to its availability.

A source from which a document announced in *STAR* is available to the public is ordinarily given on the last line of the citation. The NASA accession number is sufficient when ordering NASA and NASA-sponsored documents from NTIS. When ordering *non*-NASA documents (no asterisk) from the issuing agency or other sources, particularly NTIS, it is essential that additional bibliographic information such as the report number be given.

The following are the most commonly indicated sources (full addresses of these organizations are listed at the end of this introduction):

Avail: NTIS. Sold by the National Technical Information Service at a standard price of $3.00 for hard copy (printed, facsimile, or reproduced from microcopy) of 300 pages or less. Documents in the 301 to 600 page range are sold for $6.00 in hard copy, and those in the 601 to 900 page range are sold at $9.00. Documents exceeding 900 pages are priced by NTIS on an individual basis. These prices apply retroactively to all documents in the NTIS collection, but in addition, documents of 300 pages or less that are over two years old (from date of announcement in *Government Reports Announcements*, or *STAR* for those items announced only in *STAR*) will have a surcharge of $3.00 added for a total price of $6.00. No additional surcharge will be added for documents over 300 pages.

Microfiche is available from NTIS at a standard price of 95 cents (regardless of age) for those documents identified by the # sign following the accession number (e.g., N71-10411#) and having an NTIS availability shown in the citation. Standing orders for microfiche of (1) the full collection of NTIS-available documents announced in *STAR* with the # symbol, (2) NASA reports only (identified by an asterisk (*)), (3) NASA-accessioned non-NASA reports only (see paragraph below), or (4) any of these classes within one or more *STAR* categories, also may be placed with NTIS at greatly reduced prices per title (e.g., 35 cents) over individual requests. Inquiries concerning NTIS Selective Dissemination of Microfiche (SDM) should be addressed to the Subscription Unit, National Technical Information Service, Springfield, Virginia 22151.

Avail: SOD (or GPO). Sold by the Superintendent of Documents, U.S. Government Printing Office, in hard copy. The price is given following the availability line. (An order received by NTIS for one of these documents will be filled at the SOD price if hard copy is requested. NTIS will also fill microfiche requests, at the standard 95 cent price, for those documents identified by a # symbol. SOD does not sell microfiche.)

(1) A microfiche is a transparent sheet of film, 105 x 148 mm in size, containing up to 72 pages of information reduced to micro images (not to exceed 20:1 reduction).

Avail: NASA Scientific and Technical Information Office. Documents with this availability are usually news releases or informational brochures available without charge in paper copy.

Avail: AEC Depository Libraries. Organizations in U.S. cities and abroad that maintain collections of U.S. Atomic Energy Commission reports, usually in microfiche form, are listed in *Nuclear Science Abstracts*. Services available from the USAEC and its depositories are described in a booklet, *Science Information Available from the Atomic Energy Commission* (TID-4550), which may be obtained without charge from the USAEC Division of Technical Information.

Avail: Univ. Microfilms. Documents so indicated are dissertations selected from *Dissertation Abstracts* and are sold by University Microfilms as xerographic copy (HC) at $10.00 each and microfilm at $4.00 each, regardless of the length of the manuscript. Handling and shipping charges are additional. All requests should cite the author and the Order Number as they appear in the citation.

Avail: USGS. Originals of many reports from the U.S. Geological Survey, which may contain color illustrations, or otherwise may not have the quality of illustrations preserved in the microfiche or facsimile reproduction, may be examined by the public at the libraries of the USGS field office whose addresses are listed in this Introduction. The libraries may be queried concerning the timely availability of specific documents and the possible utilization of local copying services (e.g., color reproduction).

Avail: HMSO. Publications of Her Majesty's Stationery Office are sold in the U.S. by British Information Services (BIS), New York City. The U.S. price (including a service charge) is given, or a conversion table may be obtained from BIS.

Avail: National Lending Library, Boston Spa, England. Sold by this organization at the price shown. (If none is given, an inquiry should be addressed to NLL.)

Avail: ZLDI. Sold by the Zentralstelle für Luftfahrtdokumentation und -Information, Munich, Federal Republic of Germany, at the price shown in deutschmarks (DM).

Avail: Issuing Activity, or Corporate Author, or no indication of availability: Inquiries as to the availability of these documents should be addressed to the organization shown in the citation as the corporate author of the document.

Avail: U.S. Patent Office. Sold by Commissioner of Patents, U.S. Patent Office, at the standard price of 50 cents each, postage free. (See discussion of patents and patent applications below.)

Other availabilities: If the publication is available from a source other than the above, the publisher and his address will be displayed entirely on the availability line or in combination with the corporate author line.

EUROPEAN AVAILABILITY OF NASA AND AGARD DOCUMENTS

Facsimile copy or microfiche of NASA and NASA-sponsored documents identified by both the symbols "#" and "*" and those AGARD reports that are on microfiche may be purchased from:

ESRO/ELDO Space Documentation Service
European Space Research Organization
114, av. de Neuilly
92-Neuilly-sur-Seine, France

AVAILABILITY OF DOCUMENTS TO REGISTERED NASA INFORMATION USERS

In addition to the common availability of all documents through the above sources, a limited number of information services are provided by NASA to those having a contractual or co-

operative relation to NASA or whose scientific and engineering activities relate to space and aeronautics research. Organizations qualified to receive *STAR* without charge (see p. i) also may qualify for one or more of these services. Organizations that are not registered with NASA and wish to consider registering should request Form 713, Registration Form – Technical Publications, from the NASA Scientific and Technical Information Facility. Subject to the conditions of the approved registration forms, the following services may be made available:

Initial distribution of printed copies of NASA formal reports under specified subject categories. These selected reports, which contain the more significant NASA contributions to scientific or technical knowledge, may be recognized in *STAR* by their report numbers; they include NASA Technical Notes (NASA TN D's), Technical Reports (NASA TR R's), formally published and printed (low numbered) Contractor Reports (NASA CR's), Special Publications (NASA SP's), and selected (low numbered) Technical Translations (NASA TT F's).

Initial distribution of NASA-sponsored documents on microfiche is made to large users of NASA information for whom it would be advantageous to NASA to avoid processing numerous individual requests.

Secondary distribution of NASA reports on microfiche only (i.e., documents in *STAR* designated by both an asterisk (*) and a # symbol), may be obtained on request by registered recipients that do not receive microfiche on initial distribution. Organizations that are qualified to request reports should complete a Form 492, Document Request, for each microfiche request and transmit it to the NASA Scientific and Technical Information Facility.

Department of Defense documents (identified by the "AD" prefix) are generally available as *microfiche* on secondary distribution to (*DDC*) registered users at no cost from Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314.

NASA PATENTS AND PATENT APPLICATIONS

Patents and patent applications owned by NASA are announced in *STAR* under appropriate subject categories and are referenced in the *STAR* indexes. They are identified by U.S. Patent No. and U.S. Patent Appl. Serial No. (SN) in the report/accession number index. The NASA Case number appears in lieu of the report number in the other indexes. In the abstract section of *STAR*, patents and patent applications (those for which no patents have yet been issued) are identified by respective subtitles in the citations.

Copies of NASA *patent application specifications* are sold by the National Technical Information Service at the established unit price of $3.00 for hard copy and 95 cents for microfiche. The NASA accession number should be used for ordering from NTIS.

Microfiche, but not paper copies, of the NASA patent application specifications also are available to registered requesters only at no charge from the NASA Scientific and Technical Information Facility. (Patents, in contrast to the patent applications, are not available as microfiche nor are paper copies of patents available from this source.)

Printed copies of the NASA *patents*, when identified by the U.S. patent number, may be purchased for 50 cents each, postage free, from:

Commissioner of Patents
U.S. Patent Office
Washington, D.C. 20231

It is necessary that payment be remitted in advance, preferably by money order or check payable to the Commissioner of Patents. Prepaid purchase coupons for ordering are also available from the Patent Office.

The patents and patent applications announced in *STAR* are owned by NASA and are

available for royalty-free licensing. Requests for licensing terms and further information should be addressed to:

Assistant General Counsel for Patent Matters/Code GP-1
National Aeronautics and Space Administration
Washington, D.C. 20546

COSATI SUBJECT CATEGORY CODE

In the citation of each NASA-supported document and of some non-NASA documents is a code, e.g., CSCL 25A, that indicates the subject category assigned to it from the COSATI Subject Category List (first ed. December, 1964) published by the Committee on Scientific and Technical Information of the Federal Council for Science and Technology.

INDEXING VOCABULARY

The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is used as the authority for the indexing vocabulary that appears in the subject index. The *NASA Thesaurus* should be consulted in examining the current indexing vocabulary, including associated cross-reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the National Technical Information Service or the U.S. Government Printing Office at $8.50 for the three-volume set.

SUBSCRIPTION TO NASA-ACCESSIONED NON-NASA MICROFICHE

Organizations that wish to maintain an integrated microfiche file of aerospace-related documents in order by the "N" accession number may obtain on automatic distribution "N"-numbered microfiche of *non*-NASA documents announced in *STAR*. The "N" number is the unique number under which the document is announced in *STAR* as well as indexed in and retrieved from the NASA information store. By special arrangement with NASA, the National Technical Information Service offers, on a subscription basis, the choice of (1) all non-NASA documents announced in *STAR* for which microfiche are available, distributed in "N" accession number sequence, or (2) all non-NASA documents in any one or more of the 34 *STAR* subject categories, distributed in "N" number sequence within each of the categories. The available documents are identified in *STAR* by the "#" symbol but do not show the "*" sign. The non-NASA documents are also available from NTIS in second generation microfiche, individually or by other sequence arrangements, under the originator's accession number ("AD," "PB," etc.). Inquiries for additional information and prices should be directed to: Subscription Unit, National Technical Information Service, Springfield, Virginia 22151.

ADDRESSES OF ORGANIZATIONS

American Institute of Aeronautics and Astronautics
Technical Information Service
750 Third Ave.
New York, N.Y. 10017

Commissioner of Patents
U.S. Patent Office
Washington, D.C. 20231

British Information Service
845 Third Ave.
New York, N.Y. 10022

Defense Documentation Center
Cameron Station
Alexandria, Virginia 22314

ESRO/ELDO Space Documentation Service
European Space Research Organization
114, av. de Neuilly
92-Neuilly-sur-Seine, France

Her Majesty's Stationery Office
P.O. Box 569, S.E. 1
London, England

NASA Scientific and Technical Information Facility
P.O. Box 33
College Park, Maryland 20740

National Aeronautics and Space Administration
Scientific and Technical Information Office (KSI)
Washington, D.C. 20546

National Lending Library for Science and Technology
Boston Spa, Yorkshire, England

National Technical Information Service
Springfield, Virginia 22151

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

University Microfilms
A Xerox Company
300 North Zeeb Road
Ann Arbor, Michigan 48106

University Microfilms, Ltd.
Tylers Green
London, England

U.S. Atomic Energy Commission
Division of Technical Information
P.O. Box 62
Oak Ridge, Tennessee 37830

U.S. Geological Survey
1033 General Services Administration Bldg.
Washington, D.C. 20242

U.S. Geological Survey
601 E. Cedar Avenue
Flagstaff, Arizona 86002

U.S. Geological Survey
345 Middlefield Road
Menlo Park, California 94025

U.S. Geological Survey
Bldg. 25, Denver Federal Center
Denver, Colorado 80225

Zentralstelle für Luftfahrtdokumentation und -Information
8 München 86
Postfach 880
Federal Republic of Germany

Volume 9 Number 13 / July 8, 1971

TABLE OF CONTENTS

Subject Categories

Abstracts in the journal are grouped under the following categories:

page

01 AERODYNAMICS
Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion. **2021**

02 AIRCRAFT
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **2024**

03 AUXILIARY SYSTEMS
Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. **2029**

04 BIOSCIENCES
Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. **2031**

05 BIOTECHNOLOGY
Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences. **2035**

06 CHEMISTRY
Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. **2039**

07 COMMUNICATIONS
Includes communications equipment and techniques; noise; ratio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **2042**

08 COMPUTERS
Includes computer operation and programming; and data processing. For applications, see specific categories. For related information see also: 19 Mathematics. **2049**

09 ELECTRONIC EQUIPMENT
Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. 2053

10 ELECTRONICS
Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see specific Physics categories. 2059

11 FACILITIES, RESEARCH AND SUPPORT
Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. 2061

12 FLUID MECHANICS
Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. 2062

13 GEOPHYSICS
Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. 2069

14 INSTRUMENTATION AND PHOTOGRAPHY
Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. 2078

15 MACHINE ELEMENTS AND PROCESSES
Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; reliability; drafting; and materials fabrication, handling, and inspection. 2084

16 MASERS
Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State. 2088

17 MATERIALS, METALLIC
Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics. 2091

18 MATERIALS, NONMETALLIC
Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. 2098

19 MATHEMATICS
Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also: 08 Computers. 2102

20 METEOROLOGY
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. **2104**

21 NAVIGATION
Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. **2109**

22 NUCLEAR ENGINEERING
Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related Information see also: 03 Auxiliary Systems; and 28 Propulsion Systems. **2110**

23 PHYSICS, GENERAL
Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation. **2123**

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR
Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation. **2127**

25 PHYSICS, PLASMA
Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems. **2145**

26 PHYSICS, SOLID-STATE
Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics. **2150**

27 PROPELLANTS
Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems. **No Abstracts**

28 PROPULSION SYSTEMS
Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants. **2155**

29 SPACE RADIATION
Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics, and 24 Physics, Atomic, Molecular, and Nuclear. **2157**

30 SPACE SCIENCES
Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbits and trajectories. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. **2164**

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. **2171**

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. **2176**

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. **2184**

34 GENERAL

Includes information of a broad nature related to industrial applications and technology, and to basic research; defense aspects; information retrieval; management; law and related legal matters; and legislative hearings and documents. **2188**

SUBJECT INDEX I-1

PERSONAL AUTHOR INDEX I-65

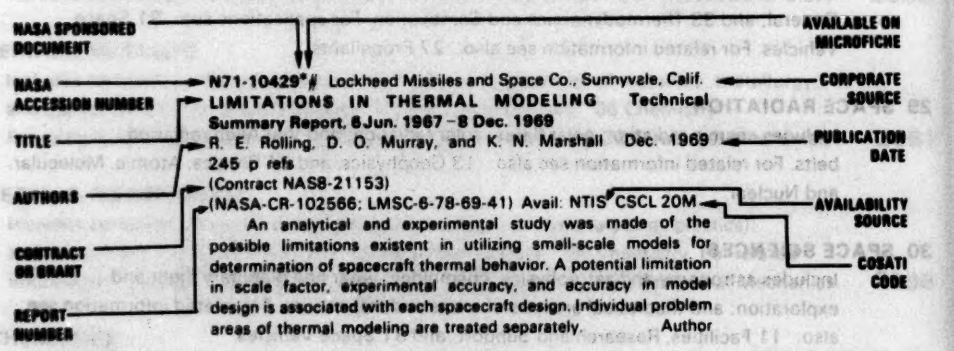
CORPORATE SOURCE INDEX I-73

CONTRACT NUMBER INDEX I-89

REPORT/ACCESSION NUMBER INDEX I-93

ACCESSION/REPORT NUMBER INDEX I-105

TYPICAL CITATION AND ABSTRACT FROM *STAR*


NASA SPONSORED DOCUMENT
AVAILABLE ON MICROFICHE
NASA ACCESSION NUMBER
N71-10429*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
CORPORATE SOURCE
TITLE
LIMITATIONS IN THERMAL MODELING Technical Summary Report, 6 Jun. 1967 - 8 Dec. 1969
PUBLICATION DATE
AUTHORS
R. E. Rolling, D. O. Murray, and K. N. Marshall Dec. 1969
245 p refs
CONTRACT OR GRANT
(Contract NAS8-21153)
AVAILABILITY SOURCE
(NASA-CR-102566; LMSC-6-78-69-41) Avail: NTIS CSCL 20M
COSATI CODE
REPORT NUMBER
An analytical and experimental study was made of the possible limitations existent in utilizing small-scale models for determination of spacecraft thermal behavior. A potential limitation in scale factor, experimental accuracy, and accuracy in model design is associated with each spacecraft design. Individual problem areas of thermal modeling are treated separately. Author

VOLUME 9 NUMBER 13 / JULY 8, 1971

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N71-24481# Fraunhofer Institut, Freiburg (West Germany).
EXPERIMENTAL AND THEORETICAL INVESTIGATIONS INTO THE INTERACTION OF SHOCK WAVES WITH CHOKES (RESTRICTIONS) IN CHANNELS [EXPERIMENTELLE UND THEORETISCHE UNTERSUCHUNGEN ZUR WECHSELWIRKUNG VON LUFTSTOSSWELLEN MIT QUERSCHNITTVERENGENDEN EINBAUTEN (DROSSELSTELLEN) IN KANAELEN]
Gerhard Guerke Nov. 1970 40 p refs In GERMAN
(Rept-9/70) Avail: NTIS

The interaction of shock waves caused by explosions with chokes in channels is investigated. Shadowgraph experiments were conducted in a shock tube with varying aperture of the choke. Calculations were based on one-dimensional flow conditions and steady flow through the choke. The numerical results are tabulated, and an average admittance curve was calculated for practical applications. ESRO

N71-24488# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.
THE TWO-DIMENSIONAL CHARACTERISTICS OF A 12.2 PERCENT THICK RAE 100 AEROFOIL SECTION
D. S. Woodward London Aeron. Res. Council 1971 71 p refs Supersedes RAE-TR-68303; ARC-31374
(ARC-R/M-3648; RAE-TR-68303; ARC-31374) Copyright. Avail: NTIS; HMSO: £1.75; BIS: $6.30

The 12.2% thick RAE 100 airfoil section was chosen as being likely to fulfil the requirements for the basic airfoil section of a series of sweptback wings designed to provide fundamental information on the high lift and stalling behavior of swept wing aircraft. The choice was based upon previously published work on the stall characteristics of twodimensional airfoils, and the results presented show that the desired behavior at high lift has been obtained. The measurements of the airfoil characteristics were obtained by surface pressure plotting. Not only were the overall forces and moments obtained from these measurements, but also the pressure distributions were analyzed in three ways intended to provide information on the changes from the potential flow pressure distribution which are produced by the displacement thickness of the boundary layer. Author (ESRO)

N71-24489# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Abteilung Aerodynamik.
SURVEY OF DIFFERENT MODELS FOR COMPUTING THE FLOW OF A LIFTING ROTOR [UEBERBLICK UEBER VERSCHIEDENE MODELLE ZUR BERECHNUNG DER ROTORDURCHSTROEMUNG]
Alfred Kussmann Dec. 1970 74 p refs In GERMAN; ENGLISH summary
(DLR-MITT-70-19) Avail: NTIS; ZLDI Munich: 13.70 DM

A survey of the essential features of several methods for computing the induced velocity field and blade loads of a lifting rotor is given, especially in the forward flight regime, with particular consideration of the different wake model configurations. Author (ESRO)

N71-24490# Max-Planck-Institut fur Stromungsforschung, Gottingen (West Germany).
NON-EXISTENCE THEOREM FOR A VISCOUS FLOW AROUND A CIRCULAR CYLINDER IN THE CASE OF A RECTILINEAR INCOMING FLOW [EIN NICHT-EXISTENZ-BEWEIS FUER DIE SCHLEICHENDE STROEMUNG UM EINEN KREISZYLINDER IM FALLE EINES GERADLINIGEN ANSTROEMPROFILS]
Rolf Reuter Jan. 1971 10 p refs In GERMAN
(Rept-1/1971) Avail: NTIS; Max-Planck-Inst. fuer Stroemungsforsch., Goettingen: 4.70 DM

It is shown, from a contradiction in the boundary conditions at the surface of a cylinder and at infinity, that in viscous flow about a cylinder no analytical solution exists. ESRO

N71-24498# Glasgow Univ. (Scotland).
A NEW SERIES OF LOW-DRAG AEROFOILS
T. R. F. Nonweiler London Aeron. Res. Council 1971 107 p refs Supersedes ARC-30528
(ARC-R/M-3618; ARC-30528) Copyright. Avail: NTIS; HMSO: £2.70; BIS: $10

A series of low drag airfoils, modelled roughly on the NACA 6-series, is described. It appears to offer theoretical advantages over its progenitor, and allows flexibility in the choice of leading-edge thickness and trailing-edge angle. Airfoils of this series are specified by five parameters, and the aerodynamic and geometrical characteristics of about 1000 of the sections are listed. The mathematical derivation of their shape (by the Lighthill method) is described in detail, and an ALGOL 60 procedure for the computation of their ordinates is included; care has been taken to construct this procedure so that it may be of general use in other applications of the Lighthill method of design. Author (ESRO)

N71-24499# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).

COMPRESSIBLE BOUNDARY LAYER FLOW PAST A SWEPT WAVY WALL WITH HEAT TRANSFER AND ABLATION

G. R. Inger Dec. 1970 46 p refs

(VKI-TN-67) Avail: NTIS

Steady small disturbances in a compressible boundary layer flow past a slightly wavy swept wall are analyzed including the effects of compressibility, heat transfer, and possible ablative response of the wall surface. The theory indicates that the nonuniform flow in the boundary layer can produce a subsonic wall pressure signature even when the local inviscid flow is moderately supersonic. For an ablating surface at high heat transfer rates, it is shown that the interaction of the gas dynamic and surface material disturbances can lead to a condition of resonance at a certain critical ratio of boundary layer thickness to surface wavelength. The results of some recent wind tunnel studies of turbulent boundary layer flows past a nonablating wavy wall in the Mach number range from 0.8 to 1.8 are also shown to corroborate theoretical predictions of both pressure and temperature perturbations. Author (ESRO)

N71-24500# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Abteilung Raumfahrt-Aerodynamik.

AN INVESTIGATION OF A WAVE-RIDER AT LOW REYNOLDS NUMBERS [UNTERSUCHUNG EINES WELLENREITERS BEI KLEINEN REYNOLDSZAHLEN]

G. Hefer Sep. 1970 32 p refs In GERMAN; ENGLISH summary

(DLR-FB-70-46) Avail: NTIS; ZLDI Munich: 9,60 DM

A Nonweiler-wing was investigated at rarefied flow conditions in order to determine the influence of small Reynolds numbers on the aerodynamic properties of wave-riders. The measurements, comprising pitot pressure surveys in the flow field, static pressure measurements, and force measurements, were performed in the slip flow region at Mach numbers of 11.5 and Reynolds numbers from 5000 to 50,000. Author (ESRO)

N71-24565# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

LOW-SPEED WIND-TUNNEL TESTS ON A SWEPTBACK WING MODEL (BUCCANEER MARK 1) WITH BLOWING AT THE WING LEADING EDGE AND BLOWING OVER THE FLAPS AND DROOPED AILERONS

S. F. J. Butler London Aeron. Res. Council 1971 54 p refs Supersedes RAE-TR-67223; ARC-29976

(ARC-R/M-3655; RAE-TR-67223; ARC-29976)

Low-speed longitudinal stability measurements are described on a fifth-scale half-model including some comparisons with complete-model tests and the measured aircraft performance. Shroud blowing over the trailing-edge flap, and drooped aileron nearly doubled the C sub l (lift coefficient) increment, to as much as 1.0, with adequate aileron roll control effectiveness at a mean aileron angle of up to 30 deg. Trimming reduced the lift increments by about 20 per cent. Despite considerable aerodynamic objections associated with the thin wing and small nose radii, and integral (nondeflecting) leading-edge blowing arrangement was specified for aircraft structural reasons. Although an acceptable arrangement was developed, this necessitated the selection of a safe compromise position for the blowing nozzle to avoid adverse compressibility effects at aircraft takeoff and landing speeds. Typically, a stalling incidence of 20 deg [C sub l max (maximum lift coefficient) = 1.8] was achieved for the proposed takeoff configuration 30 deg flap; 20 deg mean ail was achieved for the proposed takeoff configuration (30 deg flap; 20 deg mean aileron droop). With the prescribed integral leading edge, wing pitch-up at the stall was not avoided, although initial wing flow separations were confined to the inboard wing. In general, the aircraft high-lift performance confirms the results of the tests on this half-model. Author (ESRO)

N71-24569# National Physical Lab., Teddington (England). Aerodynamics Div.

MEASUREMENTS OF THE OSCILLATORY PITCHING-MOMENT DERIVATIVES ON A SERIES OF THREE DELTA WINGS IN INCOMPRESSIBLE FLOW (IN FOUR PARTS)

London Aeron. Res. Council 1971 78 p refs Part 1 supersedes NPL-AREO-1276; ARC-30359; Pt. 2, NPL-AERO-1274; ARC-30357; N69-26373; Pt. 3, NPL-AERO-1275; ARC-30358; N69-26451; and Pt. 4, NPL-AERO-1289; ARC-30955 Copyright. Avail: NTIS; HMSO: £2; BIS: $7.20

(ARC-R/M-3628-Pt-1-4; NPL-AERO-1276; NPL-AERO-1274; NPL-AERO-1275; NPL-AERO-1289 et al)

CONTENTS:

1. PART 1: MEASUREMENTS OF THE OSCILLATORY PITCHING MOMENT DERIVATIVES ON A DELTA WING WITH ROUND LEADING EDGES IN INCOMPRESSIBLE FLOW L. Woodgate p 3–21 refs (See N71-24570 13-01)
2. PART 2: MEASUREMENTS OF THE OSCILLATORY PITCHING-MOMENT DERIVATIVES ON A SLENDER SHARP-EDGED DELTA WING IN INCOMPRESSIBLE FLOW L. Woodgate p 22–38 refs (See N71-24571 13-01)
3. PART 3: MEASUREMENTS OF THE OSCILLATORY PITCHING-MOMENT DERIVATIVES ON A SHARP-EDGED DELTA WING AT ANGLES OF INCIDENCE FOR WHICH VORTEX BREAKDOWN OCCURS L. Woodgate p 39–57 refs (See N71-24572 13-01)
4. PART 4: MEASUREMENTS OF LIFT, DRAG, AND PITCHING MOMENT ON A SERIES OF THREE DELTA WINGS L. Woodgate and A. S. Halliday p 58–75 refs (See N71-24573 13-01)

N71-24570# National Physical Lab., Teddington (England). Aerodynamics Div.

PART 1: MEASUREMENTS OF THE OSCILLATORY PITCHING-MOMENT DERIVATIVES ON A DELTA WING WITH ROUND LEADING EDGES IN INCOMPRESSIBLE FLOW

L. Woodgate *In its* Meas. of the Oscillatory Pitching-Moment Derivatives on a Series of Three Delta Wings in Incompressible Flow 1971 p 3–21 refs (See N71-24569 13-01)

Copyright. Avail: NTIS; HMSO: £2; BIS: $7.20

Oscillatory pitching-moment derivatives have been measured on a round-leading-edged delta wing of aspect ratio 1.484 and of thickness to chord ratio 0.06. Mean incidence was varied from 0 to 15 deg, and frequency parameter and Reynolds number, based on the mean chord, were varied from 0.2 to 0.1 and from 1.28 million to 2.56 million respectively. Comparisons are made with similar measurements on a sharp-edged delta wing of the same aspect ratio. Differences between the results for the two models are found for both pitching axes used in the tests. From the results for h = 1.5 mean chord and from surface flow patterns, it appeared that for low angles of incidence the round leading edge suppressed the development of vortex flow sufficiently for it to have no effect on either derivative. Above alpha = 5 deg, vortex flow was gradually established, giving a change in each derivative with incidence similar to that found on the sharp-edged model. Author (ESRO)

N71-24571# National Physical Lab., Teddington (England). Aerodynamics Div.

PART 2: MEASUREMENTS OF THE OSCILLATORY PITCHING-MOMENT DERIVATIVES ON A SLENDER SHARP-EDGED DELTA WING IN INCOMPRESSIBLE FLOW

L. Woodgate *In its* Meas. of the Oscillatory Pitching-Moment Derivatives on a Series of Three Delta Wings in Incompressible Flow 1971 p 22–38 refs (See N71-24569 13-01)

Copyright. Avail: NTIS; HMSO: £2; BIS: $7.20

Oscillatory pitching-moment derivatives have been measured by an inexorable forcing method on a delta wing of aspect ratio 0.654 in pitching motion. Mean incidence has been varied from 0 to 15 deg, frequency parameter from 0.2 to 1.0, and Reynolds number from 1.28 million to 2.30 million. The derivatives showed large and approximately linear variations with incidence. Comparisons are made with previous measurements on a delta wing of higher aspect ratio also with sharp edges. In general, the numerical values of the derivatives and the variation in the derivatives due to changes in the mean incidence, frequency of oscillation, and Reynolds number are smaller for the more slender wing.
Author (ESRO)

N71-24572# National Physical Lab., Teddington (England). Aerodynamics Div.
PART 3: MEASUREMENTS OF THE OSCILLATORY PITCHING-MOMENT DERIVATIVES ON A SHARP-EDGED DELTA WING AT ANGLES OF INCIDENCE FOR WHICH VORTEX BREAKDOWN OCCURS
L. Woodgate *In its* Meas. of the Oscillatory Pitching-Moment Derivatives on a Series of Three Delta Wings in Incompressible Flow 1971 p 39–57 refs (See N71-24569 13-01)
Copyright. Avail: NTIS; HMSO: £2; BIS: $7.20

Pitching-moment derivatives have been measured on a sharp-edged delta wing of aspect ratio 1.484 for a range of incidence from alpha = 20 to 35 deg. For alpha = 30 and 35 deg, vortex breakdown occurred above the wing surface. Some numerically-low values of both the stiffness and damping derivatives were obtained for alpha = 30 deg at low frequency parameters and these are attributed to vortex breakdown. Corresponding measurements at higher frequency parameters were practically unaffected. Flow visualization showed that the pitching oscillation led to an oscillation of the streamwise position of the vortex breakdown but, for the small amplitude of oscillation used, had no effect on the mean position of the breakdown. Author (ESRO)

N71-24573# National Physical Lab., Teddington (England). Aerodynamics Div.
PART 4: MEASUREMENTS OF LIFT, DRAG, AND PITCHING MOMENT ON A SERIES OF THREE DELTA WINGS
L. Woodgate and A. S. Halliday *In its* Meas. of the Oscillatory Pitching-Moment Derivatives on a Series of Three Delta Wings in Incompressible Flow p 58–75 refs (See N71-24569 13-01)
Copyright. Avail: NTIS; HMSO: £2; BIS: $7.20

The measurements were made on three 6 percent thick delta wings; wing (1) had an aspect ratio of 1.484 and all its edges were sharp, wing (2) also had an aspect ratio of 1.484 and the leading edges were rounded, and wing (3) had an aspect ratio of 0.654 with all edges sharp. The values of C sub l (lift coefficient), C sub m (pitching moment coefficient), and the derivative delta C sub m/delta alpha obtained are compared with values predicted by a theory of Garner and Lehrian which takes into account the effects of leading-edge flow separation. The values obtained for wing (1) were in good agreement with similar measurements from other sources, C sub l being slightly larger than theory and C sub m in reasonable agreement with theory. The round leading edge of wing (2) had the predictable effect of slightly reducing the value of C sub l and numerically increasing the value of C sub m for the mid-root-chord axis, as compared with the sharp-edged wing. Wing (3) produced values much lower than both theory and reported values for flat-plate deltas of similar aspect ratio. Author (ESRO)

N71-24581*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
VERTICAL-FIN LOADS AND RUDDER HINGE-MOMENT MEASUREMENTS ON A 1/8 SCALE MODEL OF THE M2F3 LIFTING BODY VEHICLE AT MACH NUMBERS FROM 0.60 TO 1.30
Ming H. Tang Washington May 1971 43 p refs (NASA-TM-X-2286; H-650) Avail: NTIS CSCL 01A

Outboard fin loads and rudder hinge moment measurements were obtained from a 1/8 scale model of the M2-F3 lifting body vehicle tested in the 11 foot transonic wind tunnel. The tests were conducted at Mach 0.50 to 1.30. The effects of variations in rudder deflection, upper flap deflection, lower flap deflection, and angles of attack and sideslip were studied. The left outboard fin loads increased with increase in angle of attack, Mach number, rudder deflection, lower flap deflection, and negative sideslip and decreased with increasing upper flap deflection. The rudder hinge moment increased with increase in rudder dflection and, generally, with Mach number.
Author

N71-24703*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
METHODS OF OBTAINING STABILITY DERIVATIVES
M. J. Queijo *In its* Performance and Dyn. of aerospace Vehicles 1971 p 71–101 refs (See N71-24701 13-31)
Avail: NTIS HC $9.00/MF $0.95 CSCL 20D

Various methods of obtaining aerodynamic derivatives are reviewed. These methods include wind-tunnel tests, aerodynamic theory, and extraction from flight tests, with the emphasis being on flight tests. Two techniques for extracting derivatives from flight are covered in sufficient detail to indicate the procedures involved. These methods are a strict least squares approach and an iteration technique. References are listed for additional background and details of various techniques.
Author

N71-24704*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DESIGN OF BODIES FOR LOW DRAG AND HIGH PERFORMANCE IN PRACTICAL HYPERSONIC FLIGHT
E. S. Love *In its* Performance and Dyn. of Aerospace Vehicles 1971 p 103–174 refs (See N71-24701 13-31)
Avail: NTIS HC $9.00/MF $0.95 CSCL 20D

Some topics related to body shaping for minimum drag and improved performance at hypersonic speed are presented. Implications of the most frequently assumed pressure laws are reviewed from the view of practical flight regimes, and solutions expressed in exponential residuals are presented for inviscid minimum drag power-law bodies (simple and complex) for a wide range of fineness ratio. Analytical results and comparisons with experiment are given for constraints of length and diameter and legnth and volume. Experimental results from Mach numbers of 6 to 20 are presented for a series of trapezoidal bodies; the cross section of the body giving best lift drag ratio differs from that indicated in earlier work. A simple sin(2) deficiency method is presented for predicting pressures on blunt shapes; the method appears to yield results comparable to more elaborate methods requiring machine computation.
Author

N71-24706*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLUTTER AND UNSTEADY LIFT THEORY
E. Carson Yates, Jr. *In its* Performance and Dyn. of Aerospace Vehicles 1971 p 289–374 refs (See N71-24701 13-31)
Avail: NTIS HC $9.00/MF $0.95 CSCL 20D

A brief introduction to the aeroelastic problems of aircraft is given. Emphasis is on the flutter of lifting surfaces, and the most commonly used technique for the theoretical determination of flutter stability boundaries is shown. Classical theoretical methods are presented for evaluating the required oscillatory aerodynamic forces in subsonic, supersonic, and hypersonic speed ranges. Some comparisons of theoretical and experimental results are included. Rigorous mathematical developments are not emphasized.
Author

N71-24707*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF AEROELASTICITY ON STATIC AERODYNAMIC DERIVATIVES
John E. Lamar *In its* Performance and Dyn. of Aerospace Vehicles 1971 p 375–438 refs (See N71-24701 13-31)
Avail: NTIS HC $9.00/MF $0.95 CSCL 20D

The effects of aeroelasticity on some static longitudinal derivatives are considered. Different solution techniques are presented and from these techniques; one, the force-slope method (called herein), is selected by which the effects of static aeroelasticity may be computed. In order to use the force slope method, the aerodynamic (only subsonic speeds are considered) and structural influence coefficient matrices must first be determined. These methods are developed in some detail, after which solutions for a typical configuration are given. Author

N71-24709*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
GUST ALLEVIATION
William H. Phillips *In its* Performance and Dyn. of Aerospace Vehicles 1971 p 505–553 refs (See N71-24701 13-31)
Avail: NTIS HC $9.00/MF $0.95 CSCL 20D

A discussion is presented of the response of an airplane to turbulence, including techniques for the alleviation of lateral and longitudinal motions. A simplified theoretical treatment of the longitudinal response to vertical gusts, which allows calculation of the effects of various types of gust alleviation systems, is presented. Flight experiments on various gust alleviation systems are reviewed. A brief discussion is given of the application of these systems to different types of airplanes. Finally, methods of refinement of the simplified theory to include effects of horizontal gusts, unsteady lift effects, and isotropic turbulence are described. Author

N71-24996 Kansas Univ., Lawrence.
EMPENNAGE LOADS ON T-TAIL TRANSPORTS IN CONTINUOUS ATMOSPHERIC TURBULENCE
Henry Morgan Dodd, Jr. (Ph.D. Thesis) 1969 104 p
Avail: Univ. Microfilms Order No. 70-11014

Empennage loads on T-tail transports were investigated for the case of response to continuous atmospheric turbulence. A real-time analog-digital computer simulated the airplane dynamics and determined the importance of nonlinear aerodynamic loads caused by simultaneous vertical and lateral gusts. These nonlinear aerodynamic effects were determined from wind-tunnel tests in a transonic dynamics tunnel. The simulated model was assumed to be a rigid airplane with five degrees of freedom (2 longitudinal, 3 lateral), and results were obtained for both yaw damper on and damper off flight conditions. Bending moments on the stabilizer, fin tip, and fin root were chosen as typical loads, with emphasis on how loads might be altered by the nonlinear effects. Dissert. Abstr.

N71-25397*# Northrop Corp., Hawthorne, Calif.
RECIRCULATION CHARACTERISTICS OF A SMALL-SCALE VTOL LIFT ENGINE POD
Gordon R. Hall May 1971 112 p refs
(Contract NAS3-10498)
(NASA-CR-1774) Avail: NTIS CSCL 01B

Exhaust gas ingestion and recirculating flow field characteristics of a small-scale VTOL lift engine pod containing two simulated engines are reported. Results are presented for tests designed to investigate transient development of the recirculating flow field, steady state ingestion and recirculating flow field characteristics, and dynamic simulation of takeoff and landing. The steady state test results include effect of nozzle height and spacing, effect of inlet and exhaust flow conditions, and effect of wind speed and direction. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N71-24351# Army Foreign Science and Technology Center, Charlottesville, Va.
PARACHUTE [PARASHYUT]
A. Khorobrykh 24 Sep. 1970 14 p Transl. into ENGLISH from Starshina-Serzhant (USSR), no. 8, 1969 p 20–22
(AD-719480; FSTC-HT-23-400-70) Avail: NTIS CSCL 1/3

Brief historical remarks concerning parachute development in the Soviet Union are followed by a functional description of the basic components of standard personnel parachutes. Devices and methods employed to open parachutes, including manual and automatic methods are discussed and illustrated. Specific attention is devoted to a device which is pressure-controlled, with automatic timing for canopy deployment. The application and role of the parachute in areas other than aviation are discussed briefly. Author (GRA)

N71-24385# Deutsche Gesellschaft fuer Luft- und Raumfahrt, Stuttgart (West Germany).
HELICOPTER FATIGUE TESTING [BETRIEBSFESTIGKEITSPROBLEME BEI HUBSCHRAUBERN]
Dec. 1970 187 p refs In GERMAN; ENGLISH summary Proc. of the DGLR Symp. on Helicopters and Propellers, Immenstaad, West Ger., 24 Jun. 1969
(DLR-MITT-70-01) Avail: NTIS; ZLDI Munich: 38.85 DM

CONTENTS:

1. DETERMINATION OF THE LIFETIME OF HELICOPTER COMPONENTS R. Prinz (DFVLR, Brunswick) p 7–76 refs (See N71-24386 13-02)

2. STRUCTURAL STABILITY OF THE ROTOR SYSTEM OF THE HOT-GAS REACTION HELICOPTER DO 132 L. Brenner (Dornier-Werke, Friedrichshafen, West Ger.) p 77–96 refs (See N71-24387 13-02)

3. DYNAMIC TESTING OF HELICOPTER COMPONENTS H. SCHUMACHER (Messerschmitt-Boelkow) p 97–123 (See N71-24388 13-02)

4. EVALUATION OF FLIGHT MEASUREMENTS AND THE PLOTTING OF LOADING COLLECTIVES H. Strehlow (MesserschmittBoelkow) and N. Mihalcea (Messerschmitt-Boelkow) p 124–156 refs (See N71-24389 13-02)

5. STRUCTURAL STABILITY INVESTIGATIONS OF THE HELICOPTER VFW-H3 W. Paul (Ver. Flugtech. Werke, Bremen) p 157–174 (See N71-24390 13-02)

N71-24386# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany).
DETERMINATION OF THE LIFETIME OF HELICOPTER COMPONENTS [DIE ERMITTLUNG DER LEBENSDAUER VON HUBSCHRAUBERBAUTEILEN]
Rudolf Prinz *In* DGLR Helicopter Fatigue Testing Dec. 1970 p 7-76 refs In GERMAN Avail: NTIS; ZLDI Munich: 38.85 DM

A survey is given of methods used for the determination of the fatigue life of helicopter rotor blades exposed to vibrational stresses, present during normal flight conditions. ESRO

N71-24387# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

STRUCTURAL STABILITY OF THE ROTOR SYSTEM OF THE HOT-GAS REACTION HELICOPTER DO 132 [BETRIEBSFESTIGKEITSBETRACHTUNGEN AM ROTORSYSTEM DES HEISSGAS-REAKTIONSHUBSCHRAUBERS DO 132]

L. Brenner *In* DGLR Helicopter Fatigue Testing Dec. 1970 p 77–96 refs In GERMAN (See N71-24385 13-02)
Avail: NTIS; ZLDI Munich: 38.85 DM

A survey is given of the operational demands made on the rotor system DO 132, especially the rotor blades, as well as the determination of the structural stability under special conditions. ESRO

N71-25188# Royal Aircraft Establishment, Farnborough (England).

AN INVESTIGATION OF THE EFFECT OF IONIZING RADIATION ON THE BEHAVIOUR OF LOW FREQUENCY NOISE AND THE SURFACE RECOMBINATION VELOCITY OF MOS STRUCTURES [UNTERSUCHUNG DES NIEDERFREQUENTEN RAUSCHVERHALTENS UND DER OBERFLAECHENREKOMBINATIONSGESCHWINDIGEKEIT VON MOS STRUKTUREN UNTER DER WIRKUNG IONISIERENDER BESTRAHLUNG]

D. Braeunig et al Dec. 1970 14 p refs Transl. into ENGLISH from German report W70-33
(RAE-LIB-TRANS-1536; W70-23)

N71-24389# Messerschmitt-Boelkow G.m.b.H., Ottobrunn (West Germany).

EVALUATION OF FLIGHT MEASUREMENTS AND THE PLOTTING OF LOADING COLLECTIVES [AUSWERTUNG VON FLUGMESSERGEBNISSEN UND ERSTELLUNG VON BELASTUNGSKOLLEKTIVEN]

H. Strehlow and N. Mihalcea *In* DGLR Helicopter Fatigue Testing Dec. 1970 p 124–156 refs In GERMAN (See N71-24385 13-02)
Avail: NTIS; ZLDI Munich: 38.85 DM

Classification results and frequency analyses of flight load data of the Messerschmitt-Boelkow BO 105 helicopter are reviewed. The applicability to the solution of several structural stability problems is pointed out. The applied evaluation methods and the necessary use of electronic data processing are briefly described. ESRO

N71-24390# Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).

STRUCTURAL STABILITY INVESTIGATIONS OF THE HELICOPTER VFW-H3 [BETRIEBSFESTIGKEITSUNTERSUCHUNGEN VON KOMPONENTEN DES FLUGSCHRAUBERS VFW-H3]

W. Paul *In* DGLR Helicopter Fatigue Testing Dec. 1970 p 157–174 In GERMAN (See N71-24385 13-02)
Avail: NTIS; ZLDI Munich: 38.85 DM

Structural stability tests of components of the Vereinigte Flug Werke helicopter family H3/H5 are reported on. One of the major problems during the development stage was the detection of a sufficient security against rotor blade fatigue, including the connections. ESRO

N71-24433# Army Natick Labs., Mass.

A GENERAL THEORY OF PARACHUTE OPENING

Edward W. Ross, Jr. Jan. 1971 42 p refs
(AD-719698; USA-NLABS-TR-71-32-OSD) Avail: NTIS CSCL 1/3

A simple mathematical model of the opening behavior of parachutes is presented. The model predicts the drag and velocity as functions of time and also gives an estimate of opening time. The model is very general and applicable to almost any parachute. The characteristics of a specific parachute enter the model by means of certain constants that have to be chosen. Values of these constants are found for flat, circular parachutes, partly by estimation and partly by numerical experimentation. The resulting model of the opening behavior of flat, circular canopies gives reasonable agreement with experiments for several parachutes of different sizes. Insofar as generality and flexibility are concerned, this model seems to be superior to present methods of predicting opening behavior of parachutes. Author (GRA)

N71-24452# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

AIRCRAFT DEFOGGER/DEFROSTER (TRANSPARENT AREAS) Final Report

25 Jan. 1971 18 p refs
(AD-719109; MTP-7-3-522) Avail: NTIS CSCL 1/3

Procedures are described for evaluating aircraft defogger/defroster equipment operated in conjunction with environmental control units, or as an independent electrical system. Author (GRA)

N71-24457# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

COMPATIBILITY OF AVIATION MATERIEL WITH RELATED EQUIPMENT Final Report

8 Dec. 1970 11 p refs
(AD-719107; MTP-7-3-509) Avail: NTIS CSCL 1/3

The document defines procedures for evaluating the compatibility of aviation materiel with related equipment. Compatibility aspects are physical and technical characteristics, installation and removal, operation and performance, and maintenance. Incompatibility ranges from a simple nuisance factor to complete negation of the item under test, and concerned aircraft, armament, avionics and personnel materiel. Author (GRA)

N71-24459# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

SERVICING UNITS (AVIATION) Final Report

10 Dec. 1970 18 p
(AD-719102; MTP-7-3-055) Avail: NTIS CSCL 1/3

Procedures are defined for evaluating the degree of effectiveness of both portable and self-propelled ground servicing units for Army Aircraft. This procedure is concerned with improvements and modification to existing equipment, as well as new types of heaters, auxiliary power, and servicing equipment resulting from change in aircraft configuration or methods of tactical operations. Author (GRA)

N71-24461# Army Test and Evaluation Command, Aberdeen Proving Ground Md.

ENVIRONMENTAL CONTROL UNIT (ECU) Final Report

25 Jan. 1971 18 p
(AD-719101; MTP-7-3-051) Avul: NTIS CSCL 13/1

Procedures are described for evaluating aircraft ventilation heating., moisture and contamination control, cooling and heating equipment or any combination of these systems. The evaluation is described under simulated tactical conditions. Author (GRA)

N71-24582*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

NOISE MEASUREMENTS FOR A THREE ENGINE TURBOFAN TRANSPORT AIRPLANE DURING CLIMBOUT AND LANDING APPROACH OPERATIONS

W. Latham Copeland and Lorenzo R. Clark Washington May 1971 54 p refs
(NASA-TN-D-6137; L-5994) Avail: NTIS CSCL 01B

Noise measurements have been made for a three engine

turbofan transport airplane during climbout and landing approach operations in which the airplane operating procedures were carefully controlled. These controlled procedures included an orderly scheduling of operating variables such as engine power, speed, altitude, and flap settings. The results of these studies are presented for seven climbout operations involving various climb speeds, flap settings, and engine power settings and for three landing approach operations involving various glide-slope angles. In general, the results from the climbout studies indicated that the lower noise levels (6 dB to 14 dB) were associated with profiles employing lower engine powers during second-segment climb. It was also found that, for a given climb profile and climb rate, slightly higher noise levels are associated with operations employing fixed flaps than with a specified flap retraction schedule. The results from landing approach studies indicated that generally lower noise levels were associated with the steeper glide slopes. For these steeper glide slopes, noise reductions attained (4 dB to 9 dB) resulted from both the increased altitude and the lower engine powers. Author

N71-24586*# Boeing Co., Seattle, Wash.
LOW WING LOADING STOL TRANSPORT RIDE SMOOTHING FEASIBILITY STUDY Final Report
8 Feb. 1971 77 p refs
(Contract NAS1-10410)
(NASA-CR-111819; D3-8514-2) Avail: NTIS CSCL 01C

Results of an analytical study to determine the feasibility of providing satisfactory ride qualities using modern controls technology on a high performance, low wing loading STOL aircraft are given. The aircraft configuration was designed to be competitive with present high speed jet aircraft economics and block times and to meet proposed noise requirements. Author

N71-24603# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
FLIGHT LINE ANALYZERS
7 Jan. 1971 20 p refs
(AD-719675; MTP-6-3-090) Avail: NTIS CSCL 1/3

Maintenance of complex aircraft systems requires the ability to determine the completion of systems on the flight line. The document defines procedures for field testing analyzers utilized in testing systems and fault isolating components. Author (GRA)

N71-24669# Army Aeromedical Research Lab., Fort Rucker, Ala.
THE USE OF HIGH INTENSITY XENON LIGHTING TO ENHANCE US ARMY AIRCRAFT DAY/NIGHT CONSPICUITY
John K. Crosley, William E. McLean, Ronald G. Tabak, and Robert W. Bailey Jan. 1971 32 p refs
(AD-718639; USAARL-71-13) Avail: NTIS CSCL 01/2

In-flight studies were performed to compare the effectiveness of aircraft-mounted, high-intensity Xenon flashtube lights for increasing the conspicuity of small trainer helicopters during both daytime and nighttime flights. Twenty-eight subjects rated both lighted and non-lighted aircraft visibility as viewed from the ground and from air to air in differing flight modes. Data are presented to indicate the increase in aircraft conspicuity available through the application of this type of lighting. Author (GRA)

N71-24702*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STABILITY AND CONTROL CHARACTERISTICS OF STOL AND V/STOL AIRPLANES
Joseph R. Chambers *In its* Performance and Dyn. of Aerospace Vehicles 1971 p 1-69 refs (See N71-24701 13-31)
Avail: NTIS HC $9.00/MF $0.95 CSCL 01A

Some of the stability and control characteristics common to most V/STOL airplanes are discussed. In particular, specific stability and control problems of deflected slip stream, tilt wing, ducted propeller, and jet powered vehicles are covered. The contents include a variety of experimental and analytical techniques presently used to analyze the stability and control characteristics of V/STOL airplanes. Author

N71-24708*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RESPONSE OF FLEXIBLE AIRPLANES TO ATMOSPHERIC TURBULENCE
Kermit G. Pratt *In its* Performance and Dyn. of Aerospace Vehicles 1971 p 439-503 refs (See N71-24701 13-31)
Avail: NTIS HC $9.00/MF $0.95 CSCL 01A

Current random process theory methods for the estimation of the theoretical average frequency of exceeding peak responses of various levels are described, and calculated results are compared with results from flight measurements. Contents include: (1) the statictical characteristics of the airplane responses and of the turbulence velocities, (2) the relationship of these characteristics in terms of power spectral density (PSD) functions and frequency responses to a sinusoidal gust field of various wavelengths, (3) the relation of PSD functions to random time functions and to statistical parameters, (4) methods of calculating frequency responses and aerodynamic forces due to gusts, and (5) the synthesis of the responses experienced during routine flight operations. Author

N71-24711*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INTRODUCTION TO LINEAR SYSTEM ANALYSIS AND DESIGN BY USE OF STATE VECTOR APPROACH
Raymond C. Vector *In its* Performance and Dyn. of Aerospace Vehicles 1971 p 579-628 refs (See N71-24701 13-31)
Avail: NTIS HC $9.00/MF $0.95 CSCL 01A

The analysis of linear systems is first considered. The autonomous and time varying solutions of linear systems are studied. In particular the stability of linear time invariant systems is characterized, as is the stability of periodic time varying systems. Then control in linear systems is studied. First, concepts of the controllability and observability are explained, together with their relation to the determination of state-variable feedback gains and construction of state variable estimators. A practical method for calculation of feedback gains to obtain prespecified control system characteristics is also presented (differential synthesis). An example of determination of state variable feedback gains for a lifting body entry vehicle and the design of a state estimator for a simple spring mass system is included. Author

N71-24712*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OPTIMIZATION TECHNIQUES
Ernest S. Armstrong *In its* Performance and Dyn. of Aerospace Vehicles 1971 p 629-675 refs (See N71-24701 13-31)
Avail: NTIS HC $9.00/MF $0.95 CSCL 01A

A brief introduction to some of the important concepts of deterministic optimal theory is presented. The optimization of functions is treated by the methods of mathematical programing, and the optimization of definite integrals is treated by optimal control theory. Sequential and nonsequential methods are considered. Author

N71-24869*# Massachusetts Inst. of Tech., Cambridge.
AN AIRSPACE UTILIZATION MODEL FOR V/STOL TERMINAL OPERATIONS
Dorian Albert DeMaio (M.S. Thesis) Jan. 1971 95 p refs
(Contract NAS12-2081; Grant NGR-22-009-010; Contract DOT-TSC-5)
(NASA-CR-118315; TE-45) Avail: NTIS CSCL 01B

A computer graphics display program is developed for use

in terminal area studies and V/STOL approach and departure path synthesis. The computer processes inputs describing the terminal area and accompanying constraints and displays on a cathode ray tube the airspace utilization model, a three dimensional image representation of the constraints at a given altitude. Extensive machine operator interaction is provided to select various constraint criteria, to plan approaches and departures and to check the results through viewing and teletype output. The program is general and may be applied to a number of terminal areas. The programs' applicability and usefulness is demonstrated in the analyses of several proposed VTOL port sites in the Northeast Corridor. Author

N71-24920# Air Registration Board, London (England).
CIVIL AIRCRAFT AIRWORTHINESS DATA RECORDING PROGRAM: EN ROUTE USE OF FLAP
Apr. 1970 12 p ref
(ARB-TN-99; CAADRP-TR-18) Avail: NTIS

A survey of current practices relating to en-route use of flap indicates that flaps are used for descent or holding whether or not clearance for this has been obtained. On the two aircraft considered, the maximum indicated air speed for flap appears to be used as target speed and exceedances, though small, are frequent. Author

N71-25032# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILITY AND CONTROLLABILITY OF SUPERSONIC AIRCRAFT, 1970
V. Lutskii et al 4 Dec. 1970 14 p Transl. into ENGLISH from Aviatsiya i Kosmonavtika (Moscow), no. 1, 1970 p 15–18
(AD-719804; FTD-HC-23-599-70) Avail: NTIS CSCL 1/3

To a great extent, the maneuverability of a supersonic fighter is determined by the value of the maximal available overloads which vary in relation to the flight speed and height. In its turn, the maximal available overload is affected by the maximally permissible value of lift coefficient and the reserve C(subscript y)--ranging from the balancing value in straight flight to the maximally permissible value. Satisfactory parameters of stability and controllability are retained in the delta-wing fighters under condition of aerodynamic buffeting. Author (GRA)

N71-25048# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FIRST BORN OF SOVIET AVIATION SCIENCE
A. I. Makarevskii et al 15 Jan. 1970 29 p Transl. into ENGLISH from Priroda (USSR), no. 5, 1970 p 2–11
(AD-719802; FTD-MT-24-292-70) Avail: NTIS CSCL 1/2

The article briefly traces the role of the Central Aerohydrodynamic Institute im. Prof. N. E. Zhukovskiy (TsAGI) in the development of Soviet military and civilian aviation. It discusses some of the technical problems encountered in the development of subsonic, transonic, supersonic, and hypersonic flights and steps undertaken to solve them. Some of the TsAGI wind tunnels and their role in aircraft development are described. Author (GRA)

N71-25049# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILITY AND CONTROLLABILITY OF SUPERSONIC AIRCRAFT, 1969
V. Lutskii et al 4 Dec. 1970 10 p Transl. into ENGLISH from Aviatsiya i Kosmonavtika (USSR), no. 11, 1969 p 11–18
(AD-719803; FTD-HC-23-597-70) Avail: NTIS CSCL 1/3

During the piloting of supersonic aircraft with swept wings, it is important to take into account a reduction in the overload stability margin in the transonic range of speeds at relatively small angles of attack. This is connected with the unfavorable development of flow separation on the wing and the horizontal empennage under conditions of the formation and development of supersonic zones of flow and shock waves; such a condition sometimes leads to a spontaneous abrupt rise in the overloading at these speeds. Author (GRA)

N71-25050# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
FLIGHT TESTS TO INVESTIGATE THE PROBLEMS OF STEEP APPROACHES BY STOL AIRCRAFT
C. O. O'Leary and N. V. Slatter London Aeron. Res. Council 1970 43 p refs Supersedes RAE-TR-69277; ARC-31849
(ARC-CP-1138; RAE-TR-69277; ARC-31849) Copyright. Avail: NTIS; HMSO: 60p; BIS: $2.40

Steep approach tests with a Varsity and an Andover aircraft are described. Using the Varsity aircraft, 243 visual approaches were flown in a statistical experiment which included variations of approach angle, speed, height of entry to the approach, glide path guidance and pilots. A statistical analysis of the effects of the variables on various approach performance parameters was carried out and the significant results are illustrated and discussed. Tests with the Andover aircraft were on a smaller scale and were primarily concerned with the final phase of the approach and landing. The most important results of the tests are that steep approaches can be accurately and consistently made using a simple form of glide path guidance and landing distances can be decreased without any apparent increase in variability of performance. Author (ESRO)

N71-25060# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
MEASUREMENT AND ANALYSIS OF C-5A INTERIOR ACOUSTIC ENVIRONMENTS DURING FLIGHT OPERATIONS Final Report, Jul.–Aug. 1970
Justus F. Rose, Jr. Oct. 1970 11 p refs
(AD-719746; AMRL-TR-70-110) Avail: NTIS CSCL 20/1

Interior sound pressure levels produced by the C-5A aircraft were measured at sixty-six locations where crew/passenger personnel9would typically be located during operational missions. Conditions ranged from aircraft preflight through maximum endurance cruise at an altitude of 31,000 feet. These data were used to compute A-weighted and C-weighted overall sound levels, permissible exposure times with and without ear protection and preferred speech interference levels. The measured data were grouped by location/condition and each major compartment in the aircraft evaluated for human exposure to the environment. The major problem area is in the cargo compartment where the high noise levels are such that for any appreciable exposure time, ear protection must be worn to prevent risk of permanent hearing impairment. The public address system in the cargo compartment is inadequate as presently configured and coupled with the high noise levels cannot be effectively used to brief passengers during missions. Author (GRA)

N71-25065# Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.
A PILOTED SIMULATOR STUDY OF A JET VTOL AIRCRAFT IN PARTIALLY JET-BORNE FLIGHT
K. P. King and A. McPherson London Aeron. Res. Council 1971 67 p refs Supersedes RAE-TR-68301; ARC-31163
(ARC-R/M-3647; RAE-TR-68301; ARC-31163) Copyright. Avail: NTIS; HMSO: £1.75; BIS: $6.30

A simulation of a small jet VTOL aircraft has been used to examine the principles of controlling such aircraft in the partly jet-borne regime. An investigation of three alternative techniques for control at constant speed was made, from which the pilots were able to select a single control technique that was effective from the lowest speed simulated (40 kt) to the highest (150 kt). The preferred technique was to use thrust to control flight path

and thrust vector angle to control airspeed while using attitude (controlled by the elevator) to make fine adjustments to both flight path and airspeed. A preliminary study of techniques for performing the transition between wing-borne and jet-borne flight was then made. Although computation limitations precluded transitions to speeds below 40 kt, some valuable information was gained. In particular, a number of transitions were performed successfully, and without great difficulty, while following an ILS beam. As a result of these tests, it is believed that jet VTOL aircraft with adequate stability may have a greater potential than had been anticipated for operating in poor weather, without the complicated flight-director systems and automatic controls that have generally been thought to be necessary. Author (ESRO)

N71-25080# Advisory Group for Aerospace Research and Development, Paris (France).
EXTREME VALUE ANALYSIS AND ITS APPLICATION TO e. g. VERTICAL ACCELERATIONS MEASURED ON TRANSPORT AIRPLANES OF TYPE C-130
Otto Buxbaum (Lab. fuer Betriebsfestigkeit) Mar. 1971 31 p refs Presented at 31st Meeting of the Panel on Environ. Statist. Data of AGARD, Tonsberg, Norway, 1-6 Nov. 1970
(AGARD-R-579-71) Avail: NTIS

The interpretation of cumulative frequency distributions of measured flight loads can be increased significantly by an additional extreme value analysis. This method not only leads to a higher reliability in fatigue design but may be used also for a prediction of extreme loading conditions and for a description of the effect of airplane and flight parameters on loads, as is demonstrated for c.g. vertical accelerations and gust velocities measured on airplanes of type C-130. Author

N71-25092# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Flight Dynamics Lab.
PROCEEDINGS OF THE AIR FORCE CONFERENCE ON FATIGUE AND FRACTURE OF AIRCRAFT STRUCTURES AND MATERIALS
Sep. 1970 898 p refs Conf. held at Miami, 15 – 18 Dec. 1969
(AD-719756; AFFDL-TR-70-144) Avail: NTIS HC $9.00/MF $0.95 CSCL 1/3

The document is comprised of papers presented at the Air Force Conference on Fatigue of Aircraft Structures and Materials, sponsored by the Air Force Flight Dynamics Laboratory (AFFDL) and the Air Force Materials Laboratory (AFML), Air Force Systems Command. The purpose of the Conference was to discuss technological advancements in fatigue and fracture theory. The Conference was comprised of ten technical sessions (including two panel discussions) entitled The Role of Materials in Structures; Fundamentals I + II; Criteria; Fracture I + II; Phenomena I + II; Analysis; Design and Service Experience. A total of fifty-six technical papers were presented. Author (GRA)

N71-25133# Army Foreign Science and Technology Center, Charlottesville, Va.
SOVIET HELICOPTERS [SOVETSKIE VERTOLETY]
18 Feb. 1971 11 p Transl. into ENGLISH from the Russian
(AD-719585; FSTC-HT-23-1063-70) Avail: NTIS CSCL 1/3

Brief descriptions are presented for the V-10(Mi-10), Ka-25K, KA-26 and KA-22 helicopters. Author (GRA)

N71-25384*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POTENTIAL OF METHANE FUELED SUPERSONIC TRANSPORTS OVER A RANGE OF CRUISE SPEEDS UP TO MACH 4
John B. Whitlow, Jr. and Gerald A. Kraft Washington May 1971 39 p refs
(NASA-TM-X-228) Avail: NTIS CSCL 01B

A major factor restricting currently proposed SST's to a maximum cruise speed of Mach 2.7 is the limited heat sink capacity of kerosene-type fuels. Higher speeds may be possible with cryogenic liquid methane, which has up to seven times the heat sink and can be economically obtained from natural gas. In the analysis presented, methane was considered as the fuel for airplanes designed to cruise at speeds up to Mach 4. When a comparison was made at Mach 2.7 with a conventionally fueled SST, the use of methane improved both range and direct operating cost (DOC) by about 11 percent. Little range improvement was obtained by cruising faster than Mach 2.7, although certain assumptions made in this study should produce somewhat optimistic results at the higher speeds. Range peaked near Mach 3 and decreased from 6 to 13 percent as cruise speed was increased to Mach 4. The block time reductions obtained with higher cruise speeds are beneficial to DOC. Most of the possible DOC improvement was obtained by a speed increase to Mach 3.2, where a 20-minute time saving produced 7 percent improvement in DOC. Author

N71-25395# National Aerospace Lab., Tokyo (Japan).
FLIGHT DYNAMICS OF FREE FLIGHT MODEL FFM-10 AND DATA ANALYSIS METHOD FOR FREE FLIGHT TESTS
Kazuaki Takashima 1970 19 p refs In JAPANESE; ENGLISH summary
(NAL-TR-228) Avail: NTIS

The flight path and longitudinal dynamic characteristics of free-flight model FFM-10 were investigated prior to flight test. The dispersion of the range due to thrust misalignment, ground wind and aerodynamic asymmetries of the model was determined. The dispersion by the last-named cause can be eliminated by slow rolling of the FFM-10 in flight, while slow rolling causes little effect upon dispersion due to thrust misalignment and ground wind. The influence of the roll rate which brings about coupling between pitch mode and yaw mode was investigated analytically. Deceleration by as much as 6g to 7g caused by drag at Mach number 1.3 gives such a small reduction of frequency of short period mode that the flight speed can be assumed to be constant. The procedure of analyzing flight data is briefly described. Author

N71-25396# National Aerospace Lab., Tokyo (Japan).
A MODEL TEST ON THE HOVERING PERFORMANCE OF JET FLAPPED ROTOR
Masaki Komoda, Tohichi Oka, Kingo Takasawa, and Nobuhiro Toda 1970 18 p refs In JAPANESE; ENGLISH summary
(NAL-TR-211) Avail: NTIS

A model test was conducted to investigate the hovering performance of jet-flapped rotors with special attention to the comparison with that predicted theoretically. The jet-augumented thrusts and torques were measured for given sets of rotor rpm and mass flow rate. Except for the fact that considerably smaller rates of mass flow were measured than predicted, which is attributable to pressure loss within the nozzle area, the general dependence of measured thrust and torque coefficients upon mass flow and rotor rpm exhibits acceptable agreement with theoretical predictions based on the annular momentum theory in conjunction with two-dimensional jet-flapped airfoil theory. Author

N71-25537*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
IN-FLIGHT EVALUATION OF THE LATERAL HANDLING OF A FOUR-ENGINE JET TRANSPORT DURING APPROACH AND LANDING
Euclid C. Holleman and Glenn B. Gilyard Washington May 1971 31 p refs
(NASA-TN-D-6339; H-642) Avail: NTIS CSCL 01B

The lateral handling of a typical jet transport was evaluated during up-and-away and approach flight in the landing configuration. Sidestep maneuvers to a landing were performed with several

levels of lateral control power in smooth-air conditions. A roll control power capability of about 15 degrees per second was required for satisfactory lateral control. 200-foot lateral offsets to the runway could be safely corrected with very low levels of lateral control power, approximately 2 to 5 degrees per second, using altered piloting techniques. The pilot evaluation results were in general agreement with results from other studies. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N71-24377# Army Electronics Command, Fort Monmouth, N.J.
LOW POWER METHANOL/AIR BATTERY
John Perry, Jr. Nov. 1970 26 p refs
(AD-719239; ECOM-3365) Avail: NTIS CSCL 10/3

Investigations of methanol/air battery cells, using KOH electrolyte at room temperature (21C), show that current densities of 15 m A/sq cm at 0.60 V can be obtained. Single cells operated for more than 400 hours at current densities of 10 to 12 mA/sq cm constant current (0.67 to 0.80 A). These small cells had reactant-electrolyte capacities to operate for more than 40 hours on a single filling. The cells operated without a membrane or separator protection for the cathode with faradaic reactant efficiencies as high as 80% during a cycle. The anode electrode contained a Pt:Pd catalyst and the cathode electrode, a silver catalyst. Author (GRA)

N71-24605* Aerojet-General Corp., El Monte, Calif.
AUTOMATIC BATTERY CHARGER Patent
David K. Warkentine, inventor (to NASA) Issued 26 Nov. 1968 (Filed 10 Jun. 1966) 8 p Cl. 320-17 Sponsored by NASA
(NASA-Case-XNP-04758; US-Patent-3,413,536; US-Patent-Appl-SN-557861) Avail: US Patent Office CSCL 10C

A plurality of series connected batteries are successively charged automatically from a charging current source. The battery charge, as measured by its output potential, is compared with a reference and stepping-switch means are provided for adjusting the charge accordingly. Further, the charging state of the battery is indicated. When the battery is fully charged, the charging current is discontinued. Official Gazette of the U.S. Patent Office

N71-24615# General Electric Co., Philadelphia, Pa. Missile and Space Div.
PERFORMANCE OF A LARGE SCALE NONEQUILIBRIUM MHD GENERATOR WITH RARE GASES: ERRATUM
B. Zauderer Feb. 1970 18 p refs Amendment to AD-703314
(Contract N00014-70-C-0321)
(AD-719380; AD-703314; ONR-TR-14; Rept-70SD4E) Avail: NTIS CSCL 10/2

An experimental study was performed of the operating characteristics of a large linear, supersonic MHD generator. A shock tunnel was used to heat the test gases, which was primarily a 99 percent neon + 1 percent xenon mixture, to stagnation pressures of 1 to 5 atmospheres, temperatures of about 3500 degrees K, and electron densities on the order of 10 to the power of 10/cc. The test time of 5 milliseconds, which was about 10 times the traversal time of the gas through the generator, was sufficient to produce quasi-steady state conditions in the channel. Author (GRA)

N71-24617*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPACE TECHNOLOGY APPLICABLE TO HYBRID VEHICLE BATTERIES
Harvey J. Schwartz [1971] 8 p refs To be presented at 1971 Intersoc. Energy Conversion Eng. Conf., Boston, 3-6 Aug. 1971; sponsored by SAE
(NASA-TM-X-67812) Avail: NTIS CSCL 10C

The application of aerospace battery technology which could increase the life of nickel zinc batteries is discussed. The purpose of the investigation is to recommend electric batteries which are suitable for use in hybrid engine/electric systems of low pollutant propulsion systems. Author

N71-24628*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
STRUCTURAL ANALYSIS OF SILICON SOLAR ARRAYS
L. W. Butterworth and R. K. Yasui 15 May 1971 39 p refs
(Contract NAS7-100)
(NASA-CR-118286; JPL-TR-32-1528) Avail: NTIS CSCL 10A

The structural design of solar arrays is considered. Different areas of examination include thermal stresses in array components, mechanical stresses in solar arrays, analysis of a stress relief interconnect, and current material properties. Special emphasis has been placed on developing simple but accurate methods of analysis that will be of use to the designer. Author

N71-24680# General Electric Co., Philadelphia, Pa. Space Div.
EXPERIMENTS IN A LARGE, NON-EQUILIBRIUM MHD GENERATOR WITH CESIUM SEEDED, NOBLE GASES AND HEATED ELECTRODES
B. Zauderer and E. Tate Feb. 1971 19 p refs
(Contracts N00014-70-C-0321; Nonr-3867(00))
(AD-719381; TR-17) Avail: NTIS CSCL 10/2

An experimental study was performed of the operating characteristics of a linear, supersonic Faraday generator, having heated wire electrodes suspended in the gas flow. The test gases were argon, neon, helium seeded with 0.8% cesium. It was observed that locating the electrode outside the cold boundary layer greatly reduced the current ignition voltage at the electrodes below that obtained previously with flush mounted electrodes. However, heating the electrodes to 1600K temperatures produced no significant improvement in the electrode performance over that obtained with room temperature electrodes at current densities of about 10 amp/sq/cm. In both cases, the electrode conduction was through arc spots with cathode losses of about 60V. Author (GRA)

N71-24681* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHOD OF ATTACHING A COVER GLASS TO A SILICON SOLAR CELL Patent
Joseph Mandelkorn, inventor (to NASA) Issued 24 Nov. 1970 (Filed 17 Mar. 1969) 4 p Cl. 29-572; Int. Cl. B01J17/00; Int. Cl. H01c7/08; Int. Cl. H01g9/00; Int. Cl. H01l15/02 Continuation-in-part of US Patent Appl. SN-641420, filed 18 May 1967
(NASA-Case-XLE-08569-2; US-Patent-3,541,679; US-Patent-Appl-SN-629825) Avail: US Patent Office CSCL 10A

A method is described for attaching cover glasses to solar cells without using adhesive. Each cover glass is metallized in a pattern identical to the top contact pattern of a solar cell. The glass is bonded to the cell only within the metallized regions of glass and cell. Official Gazette of the U.S. Patent Office

N71-24718* Garrett Corp., Los Angeles, Calif.
WATER MANAGEMENT SYSTEM AND AN ELECTROLYTIC CELL THEREFOR Patent
Charles F. Albright and Joseph B. Gillerman, inventors (to NASA)

Issued 15 Dec. 1970 (Filed 8 Aug. 1968) 8 p Cl. 204-305; Int. Cl. B01k1/00 Sponsored by NASA
(NASA-Case-MSC-10960-1; US-Patent-3,547,801; US-Patent-Appl-SN-751198) Avail: US Patent Office CSCL 06K

A water management system formed of a waste water system which interfaces with a potable water system so that potable water is available in emergency situations is described. There is a normally long residence time in each system. An electrolytic cell is formed of a housing having an inlet and an outlet with a silver anode surrounded by a silver cathode located in the fluid flow path. An electrical control system consisting of a battery and resistors limits the current to achieve the proper concentration of silver ions for bactericidal control without creating a health hazard. Official Gazette of the U.S. Patent Office

N71-24719* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COULOMETER AND THIRD ELECTRODE BATTERY CHARGING CIRCUIT Patent
John Paulkovich and Floyd E. Ford, inventors (to NASA) Issued 17 Nov. 1970 (Filed 29 May 1969) 8 p Cl. 320-39; Int. Cl. H02j7/04; Int. Cl. H01m45/04
(NASA-Case-GSC-10487-1; US-Patent-3,541,422; US-Patent-Appl-SN-828983) Avail: US Patent Office CSCL 10B

A battery charging circuit in which all available current to a battery is controlled through the use of a coulometer connected in parallel with a current limiting means such as a trickle resistor is described. At least one of the battery cells is of the type having a third electrode which is connected to a third electrode resistor in series with the trickle resistor. A voltage sensing circuit detects the sum of voltage across the coulometer and the third electrode. When the sum of the voltages exceeds a predetermined level, the sensing circuit actuates a control means, for preventing further flow of charging current to the battery. Additionally, the device may be further provided with a current limiting resistor connected in series with the coulometer, and either in series with or in parallel with the trickle resistor. Official Gazette of the U.S. Patent Office

N71-24919*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Guidance and Control Div.
RESULTS OF THE 1969 BALLOON FLIGHT SOLAR CELL STANDARDIZATION PROGRAM
Richard F. Greenwood 1 May 1971 18 p refs
(Contract NAS7-100)
(NASA-CR-118272; JPL-TR-32-1530) Avail: NTIS CSCL 10A

High-altitude calibration of solar cells was accomplished with the aid of free-flight balloons. Flights were to an altitude of 36,576 m, a 12,192-m altitude increase over the 1968 flights. Solar cells calibrated in this manner are recovered and used as intensity references in solar simulators and in terrestrial sunlight. Attempts to fly radiometers on two separate flights met with only partial success. Comparison of solar cell data taken at altitudes of 24,384 m and 36,576 m was made. Solar cells with altered spectral response characteristics showed an approximate 1% increase in short-circuit current at the higher altitude. A sky radiation experiment was also conducted. Results indicate that there is no detectable sky radiation at 36,576 m when measured with the normal balloon instrumentation and telemetry techniques. Author

N71-24930*# Heliotek, Sylmar, Calif.
DEVELOPMENT OF LITHIUM DIFFUSED RADIATION RESISTANT SOLAR CELLS Third Quarterly Report
P. A. Payne Apr. 1971 21 p Prepared for JPL
(Contracts NAS7-100; JPL-952547) Avail: NTIS CSCL 10A
(NASA-CR-118318) Avail: NTIS CSCL 10A

The development of a boron diffusion process which can be used to diffuse large quantities of stress-free high efficiency, lithium diffused, radiation resistant solar cells is described. Two processes are presented: (1) a modification of the standard boron chloride diffusion, involving reduction of the boron deposition time and (2) the use of boron chloride with oxygen. Author

N71-24963*# TRW Systems Group, Redondo Beach, Calif.
STUDY AND DETERMINATION OF AN OPTIMUM DESIGN FOR SPACE UTILIZED LITHIUM DOPED SOLAR CELLS Quarterly Report
R. G. Downey 15 Apr. 1971 37 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952554)
(NASA-CR-118317; TRW-13154-6019-R0-00) Avail: NTIS CSCL 10A

A large group of lithium doped solar cells was evaluated for radiation resistance. The cells represented a lithium diffusion time-temperature matrix. The evaluation results indicated that the higher temperature and longer diffusion time cells have undesirable variations in lithium concentration. The lithium concentrations in the cells were found to be decreasing with time in the range covered by the diffusion matrix. The relation between initial solar cell output and lithium concentration was confirmed. Capacitance-voltage techniques were used to study the changes in lithium donor concentration during the recovery period. The results indicate that previous attempts to use ion pairing to explain the recovery are inadequate. The new data indicate that radiation defects act as nuclei which allow the lithium donor to precipitate and neutralize the defect. Author

N71-25045*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MEASURED PERFORMANCE OF SILICON SOLAR CELL ASSEMBLIES DESIGNED FOR USE AT HIGH SOLAR INTENSITIES
Ronald G. Ross, Jr., Robert K. Yasui, Wiktor Jaworski, Liang-Chi Wen, and Edward L. Cleland 15 Mar. 1971 218 p refs
(Contract NAS7-100)
(NASA-CR-118326; JPL-TM-33-473) Avail: NTIS CSCL 10A

The results are presented of an experimental program undertaken to evaluate the performance of three solar panel design approaches suitable for use at high solar intensities: the second-surface mirror mosaic approach, the selective bandpass filter approach, and the tilted panel approach. Extensive data are given on the thermal and electrical characteristics of a number of specific cell/coverglass assemblies representative of these approaches. Included are data on electrical performance at intensities from 1 to 6 suns, data on thermal optical properties both before and after long term-UV and proton radiation exposure, and data on the thermal-mechanical properties of a number of solar cell adhesives. Author

N71-25051# Ministry of Technology, London (England). Reports Centre.
GAS BOTTLES FOR AIRBORNE USE
F. Featherstone Oct. 1970 23 p
(TRC-BR-22373; S/T-Memo-8-70) Avail: NTIS

The reliability requirements and the testing of pressurized gas containers to be used onboard aircraft are described. Different types of containers are considered. Steel bottles, wire-wound cylinders, welded steel cylinders, and aluminum alloy bottles. ESRO

N71-25309*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LOW INPUT VOLTAGE CONVERSION FROM UNCONVENTIONAL PRIMARY (RTG'S) AND SECONDARY (BATTERY) SOURCES
Edward R. Pasciutti *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 229-232
(See N71-25256 13-34)
Avail: NTIS HC$8.00/MF$0.95 CSCL 10A

A single cell low input voltage regulator is described that is able to provide intermittent peak power demands for deep space mission power sources. This storage device uses a push-pull inverter process to generate a stepped-up ac voltage output that is then rectified to obtain the higher dc voltage output. A new total cycle, load related, base-current shaping circuit eliminates harmful effects of transistor storage time and implements crossover inductance of prescribed value in the frequency determining loop. A secondary winding of the output transformer provides load related current feedback and prevents short circuit loading. This circuit design improves inverter-converter reliability by several orders of magnitude and reliability from 5- to 10-year lifetimes. G.G.

N71-25310*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

USE OF THE THIRD ELECTRODE AND THE RECOMBINATION ELECTRODE IN SPACECRAFT BATTERIES

Floyd E. Ford *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 233-237 (See N71-25256 13-34)

Avail: NTIS HC$6.00/MF$0.95 CSCL 10C

Third electrode charge control operation in a nickel-cadmium cell is considered; the third electrode is sensitive to oxygen pressure and provides an electrical control signal to enhance gas recombination rate within the cell. The introduction of a recombination electrode advances oxygen recombination rate where the oxygen pressure in the cell falls off rapidly so that the third electrode signal is below the threshold level by the time the solar array acquires the Sun for the next charge period, thereby reinitiating the battery charging cycle. Cells containing the recombination electrode, along with the signal electrode, are designed into the nickel-cadmium battery system for the Apollo Telescope Mount (ATM). G.G.

N71-25394*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SHORTING PATH MODE OF DEGRADATION IN COPPER SULFIDE, CADMIUM SULFIDE THIN FILM SOLAR CELLS

Larry R. Scudder, Michael P. Godlewski, John M. Bozek, and Thomas M. Klucher Washington May 1971 25 p refs

(NASA-TN-D-6362; E-5347) Avail: NTIS CSCL 10A

Copper sulfide - cadmium sulfide thin film solar cells were subjected to dark forward bias tests and tests under air-mass-one illumination while in the open circuit condition. The solar cells were observed to degrade from 20 to 50 percent in maximum power, from 5 to 10 percent in open circuit voltage, and from 50 to 95 percent in shunt resistance. Associated with the degradation due to these tests was the appearance of hotspots on the cells and metallic copper on the surface of and within the cells. The degradation mechanism for these two test conditions was resulted in shorting paths within the cell. Author

N71-25420*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

VOLTAGE TRANSIENTS DUE TO PHASE ANGLE SWITCHING OF SPEED CONTROL POWER FOR A BRAYTON CYCLE ALTERNATOR

Richard C. Bainbridge and James Nestor Washington May 1971 15 p refs

(NASA-TM-X-2291; E-5697) Avail: NTIS CSCL 10A

The voltage transients resulting from phase-angle switching of the Brayton cycle alternator speed control circuit were investigated. The alternator, speed control circuits, and the parasitic load were simulated on an analog computer. This simulation confirmed that these voltage transients resulted from the effect of the self-inductance of the alternator on the rapidly switching currents of the speed control. It was also demonstrated that an inductance-capacitance line filter, presently designed into the speed control circuit, effectively suppressed these transients from the alternator output terminals. Author

N71-25534*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECT OF CELL VINTAGE AND CERTAIN TESTING PROCEDURES ON DEGRADATION OF CADMIUM SULFIDE THIN-FILM SOLAR CELLS

Thomas M. Klucher and Anthony F. Ratajczak Washington May 1971 16 p refs

(NASA-TM-X-2292; E-6041) Avail: NTIS CSCL 10A

Vacuum thermal cycling tests, simulating an earth orbit environment, were performed on 23 cadmium sulfide thin-film solar cells to determine the effect of four factors on cell performance. The factors under study were: test facility, cell vintage, cell electrical interconnection, and cell load and measurement procedure. A multiple linear regression analysis indicated that differences in open-circuit voltage results between different test facilities were significant. Based upon the t statistics calculated from the regression analysis, the probability that the open-circuit voltage and test facility are independent was found to be 0.3 percent. Other performance-factor relations studied were less significant. However, considerable scatter in the data due to unknown variables may have introduced spurious effects on the results. Author

N71-25535*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FEP COVERS FOR SILICON SOLAR CELLS

A. F. Forestieri, S. A. Greenberg (Lockheed Missiles and Space Co., Palo Alto, Calif.), M. McCargo (Lockheed Missiles and Space Co., Palo Alto, Calif.), and W. L. Palmer [1971] 12 p refs Proposed for presentation at 1971 Intersoc. Energy Conversion Eng. Conf., Boston, 3-6 Aug. 1971; sponsored by SAE Prepared in cooperation with Lockheed Missiles and Space Co., Palo Alto and Sunnyvale, Calif.

(NASA-TM-X-67824) Avail: NTIS CSCL 10A

The results are presented of a program designed to evaluate the feasibility of utilizing FEP (fluorinated ethylene propylene) as a replacement for conventional silicon solar cell covers. Techniques for heat sealing FEP to individual solar cells and modules are described with emphasis upon the effects of processing parameters on the optical and electrical characteristics of the cells. Evaluation of the effectiveness of the processing based on visual examination of bond integrity, solar cell damage, bond strength tests, and electrical output under simulated sunlight is discussed. The effects of environmental testing on single cell and module performance are documented. Tests consisted of exposure to high humidity and temperature, thermal shock, ultraviolet, proton and electron irradiation. A direct comparison between FEP and conventional glass cover materials is provided with respect to optical and physical properties, application techniques, environmental stability and economic considerations. Test results indicate no apparent drawbacks to the use of FEP covers for solar cells. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N71-24436*# Wisconsin Univ., Madison.

BIOCIDAL EFFECTS OF SILVER Final Technical Report

Dean O. Cliver, Wesley K. Fosli, and John M. Goepfert Feb. 1971 64 p

(Contract NAS9-9300)
(NASA-CR-114978) Avail: NTIS CSCL 06O

The ability of silver ions to kill or inactivate microbial and viral agents in very pure water and possible application to the design of future spacecraft water systems is discussed. Salts of silver were employed in many of these experiments, but silver from an electrolytic ion generator was used when possible. Fairly extensive results of sampling previous prototypes and spacecraft water systems were available to guide the choice of test organisms. Many of the bacteria were laboratory or prototype strains, but some had actually been isolated from water systems. The viruses were selected very arbitrarily to represent several groups. There had been no previous effort to detect viruses which might be present in spacecraft water systems, but at least two of the groups represented here are detected fairly frequently in community wastewater. Author

N71-24437# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

HUMAN PERFORMANCE AS A FUNCTION OF DIRECTION AND FREQUENCY OF WHOLE BODY VIBRATION Final Report, Sep. 1968 – Sep. 1969

Richard W. Shoenberger Oct. 1970 24 p refs
(AD-719745; AMRL-TR-70-7) Avail: NTIS CSCL 5/10

Human performance on a task complex made up of two-dimensional compensatory tracking and visual discrimination reaction time was measured during sinusoidal vibration in each of the three major translational axes (X, Y, and Z). A separate experiment was conducted for each axis, with the subjects seated upright in all experiments. Frequencies tested in each axis were 1, 3, 5, 8, and 11 Hz, at 0.2g and 0.4g. Duration of vibration at each frequency was 9 minutes. Y-axis vibration produced pronounced decrements in both tracking and reaction time with the greatest interference occurring at 3 Hz and 1 Hz, and the least at 11 Hz. For the X and Z axes low-frequency effects were smaller and performance curves across frequency, for constant g levels, were flatter with slightly greater effects at 5 Hz. Horizontal and vertical component scores for the tracking tasks were analyzed with regard to mechanical interference effects for each direction of vibration, and an analysis of frequency effects was made in relation to body resonance phenomena. Author (GRA)

N71-24454*# TRW Systems Group, Redondo Beach, Calif. Guidance and Control Systems Dept.

ARTIFICIAL GRAVITY SPACE STATION PHYSIOLOGICAL EFFECTS AND DESIGN CRITERIA

J. E. Earl 15 Apr. 1971 65 p refs
(Contract NAS9-8166)
(NASA-CR-114982; TRW-17618-H125-R0-00) Avail: NTIS CSCL 06P

A review was conducted from available literature of physiological effects on man in a rotating environment. To this was added the requirements and constraints that will be imposed by a revolving space station to develop design criteria for an artificial gravity spacecraft. These criteria relate to dynamic and geometric properties in spacecraft design that must be limited in order to provide an environment within which man can be safe, feel comfortable, and perform well. Further, the design criteria proposed increases the maximum spin rate from 4 to 6 rpm, places no upper limit on the radius of rotation, and provides design limits for additional parameters such as angular acceleration, angular jerk, vibration, and noise. Author

N71-24456# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Bad Godesberg (West Germany). Inst. fuer Flugmedizin.

QUANTITATIVE ANALYSIS OF GAMMA AMINO BUTYRIC ACID IN BRAIN EXTRACTS AFTER LONG LASTING COMPULSIVE LOCOMOTION AND BREATHING OF PURE OXYGEN [QUANTITATIVE ANALYSE VON GAMMA AMINO BUTTERSAEURE IN GEHIRNEXTRAKTEN NACH LANGDAUERNDER ZWANGSLOKOMOTION UND ATMUNG VON REINEM SAUERSTOFF]

Gerhard Schaefer and Jean-Claude Delhaye Jan. 1971 24 p refs In GERMAN; ENGLISH summary
(DLR-FB-71-03) Avail: NTIS; DFVLR Porz: 6.70 DM

The transmission reaction at the synapses, the key structures of the nervous system, are caused by means of chemical transmitter substances. Amongst these substances, gamma amino butyric acid (Gaba) seems to be responsible for the lowering of the excitatory state of the postsynaptic cell. In the organism, this amino acid is formed and disintegrated purely in the metabolism of the nerve cell, so that its synthesis and utilization are of special importance for the excitatory condition of the whole nervous system. The influence of REM-sleep deprivation and/or hyperbaric oxygenation (1 atm absolute) on Gaba-concentration is investigated in animal experiments. The change caused by REM-sleep deprivation stands in direct relationship to the effect induced by 5-hydroxy tryptamine (serotonin). The change induced by breathing of pure oxygen may probably be regarded as a protective mechanism against oxygen intoxication. Author (ESRO)

N71-24466# Royal Swedish Academy of Engineering Sciences, Stockholm.

DEVELOPMENT OF SEPARATION METHODS APPLIED TO BIOCHEMICAL MATERIALS

Arne Tiselius *In its* De Laval Mem. Lecture/1970 p 17–33 refs (See N71-24464 13-34)
Avail: NTIS

The development of separation methods applied to biochemical materials is reviewed. Among the methods described are the ultracentrifuge separator, electrophoresis, ion exchanging, and chromatography. These methods are discussed in relation to proteins, amino acids, and gels. ESRO

N71-24553*# Technology, Inc., San Antonio, Tex. Life Sciences Div.

THE METABOLISM OF INGESTED PEROXIDES Final Report, 1 May 1970 – 30 Apr. 1971

Brian Ward and Margaret Smith Apr. 1971 16 p ref
(Contract NAS9-10826)
(NASA-CR-114998) Avail: NTIS CSCL 06P

A rat feeding program to study growth patterns in albino laboratory rats having balanced diets differing by the presence of either oxidized or unoxidized fat is presented. The control group rats of both sexes, which were fed unoxidized lard, consistently gained more weight than did the test group which ate the oxidized lipid diet. The food consumption generally correlated directly with body weight gain. The male rats, of both the test and control groups, ate more food and gained more weight than did the females. The control males, with the unoxidized fat diet, ate about 8% more food than the test males with the oxidized fat diet, and gained 18% more weight. The control females ate approximately the same amount of food as the test females and gained 9% more weight. Author

N71-24584*# Techtran Corp., Glen Burnie, Md.

INVESTIGATIONS INTO THE GROWTH OF BACILLUS COLI BY DIRECT MICROSCOPIC OBSERVATION. THE PERIODICITY OF BACTERIOPHAGE ACTIVITY STUDIED ON THE BASIS OF THE OBSERVATIONS MADE IN THE COURSE OF THESE EXPERIMENTS [DURCH DIREKTE MILROSKOPISCHE BEOBACHTUNG AUSGEFUEHRTE UNTERSUCHUNGEN UEBER DAS WACHSTUM DES COLI-BAZILLUS. DIE PERIODIZITAET DER BAKTERIOPHAGENWIRKUNG, VON DEN BEI DIESEN UNTERSUCHUNGEN GEMACHTEN BEOBACHTUNGEN AUS

UNTERSUCHT]

K. A. Jensen Washington NASA May 1971 45 p refs Transl. into ENGLISH from Centralblatt fuer Bakteriol., v. 107, no. 1-3, 1928 p 1-34

(NASA-TT-F-13652) Avail: NTIS CSCL 06M

After a brief survey and critique of the various methods of quantitative determination of bacterial growth, the most important works on conditions of bacterial growth are discussed. A technique is described which is based on Oerskov's pure-culture method by which it is possible to describe and measure bacterial growth by direct microscopic observation. Author

N71-24627# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

PHYSIOLOGICAL DATA ON SWINE FOR USE IN RADIOBIOLOGY: PLASMA AND BLOOD VOLUMES [DONNEES PHYSIOLOGIQUES SUR LE PORC UTILISABLES EN RADIOBIOLOGIEB VOLUME PLASMATIQUE ET VOLUME SANGUIN]

Jacques Remy, Bernard Perdereau, and Pierre Nizza Jun. 1970 16 p refs In FRENCH

(CEA-R-4031) Avail: AEC Depository Libraries

Plasma and blood volumes of Corsican swine were measured using dilution with Evans blue (T 1824). A value for plasma volume of 50 ml/kg of live weight was found with a hematocrit of 38. The technique used was compared with those used elsewhere and the results were compared with those published for swine and man. Blood volumes in the animals used in this experiment were lower by one third than the ones measured in humans of the same weight. Red blood cells were labeled with Cr-51 and P-32 for determinations of whole blood volume, and I-131 labeled albumin was used for measuring plasma volume. NSA

N71-24682# Navy Experimental Diving Unit, Washington, D.C.

EFFECT OF IMMERSION ON THE EXCHANGE OF OXYGEN IN THE LUNG Final Report

E. T. Flynn 31 Jan. 1971 13 p refs

(AD-719389; NEDU-RR-1-71) Avail: NTIS CSCL 6/19

Steady state pulmonary gas exchange measurements were obtained in two resting subjects breathing a mixture of helium and oxygen at a simulated depth of 5 feet of sea water in a hyperbaric chamber. Measurements were obtained first with the subjects in a dry environment and then with the subjects immersed to the chin in warm water. Immersion was associated with a 1.3-1.7 mmHg increase in arterial carbon dioxide tension, a 13.2-13.3 mmHg decrease in arterial oxygen tension, and a 12.0-15.6 mmHg rise in alveolar-arterial oxygen gradient. Respiratory frequency, minute ventilation, tidal volume, and oxygen consumption remained unchanged. Physiologic dead space decreased slightly in one subject, but remained unchanged in the other. The observed impairment in oxygenation of arterial blood is thought to be related to the development of alveoli in the lung bases with ratios of ventilation to perfusion significantly less than one. Author (GRA)

N71-24683# Navy Experimental Diving Unit, Washington, D.C.

INITIAL EVALUATION OF REVISED HELIUM-OXYGEN DECOMPRESSION TABLES Final Report

John M. Alexander, Edward T. Flynn, Jr., and James K. Summitt 23 Oct. 1970 101 p refs

(AD-719388; NEDU-RR-14-70) Avail: NTIS CSCL 6/11

Fifty-four man dives were undertaken to evaluate three representative tables from a revised set of HeO2 schedules. These tables were calculated using the classical Haldane method and used the set of M values derived by Workman in 1965 as limits. A 33% incidence of decompression sickness occurred using surface decompression procedures. It was subsequently recommended that further testing of the schedules was unwarranted at this time. Further evaluation of the M values was recommended. Author (GRA)

N71-24737*# National Aeronautics and Space Administration, Washington, D.C.

ON THE VARIATIONS OF LEUCOCYTOSIS [UERER DIE VARIATIONEN DER LEUKOCYTOSE]

A. Goldscheider et al May 1971 96 p refs Trans. into ENGLISH from Z. Klin. Med. (Heidelburg), v. 25, 1894 p 393-448

(NASA-TT-F-13628) Avail: NTIS CSCL 06E

Artificial changes of leuckocyte count in the blood are examined in extensive experiments with rabbits. Some of the older (19th century) theories regarding leuckotosis and leuckocytes are reviewed. Numerous substances were injected into various organs and the changes in the count were observed and analyzed. Some of the older theories are refuted on the basis of the described experiments. The application to human subjects is discussed. Author

N71-24745# Civil Aeromedical Inst., Oklahoma City, Okla.

AVIATION MEDICINE TRANSLATIONS: ANNOTATED BIBLIOGRAPHY OF RECENTLY TRANSLATED MATERIAL, 6

Ruth Ann Mertens, C. Dene Lacy, D. R. Goulden, and Karen N. Jones Jan. 1971 8 p refs

(FAA-AM-71-5) Avail: NTIS

An annotated bibliography of translations of foreign-language articles is presented. The 22 entries are concerned with studies in aviation medicine, vestibular function, body temperature, color vision, cholinesterase, nystagmus, alcohol, vestibulocuiomotor funti, anatomy, stress and air traffic control work, flight stress, anti-smoke hoods, histology, exercise, cardiology, histochemistry, air evacuation, respiration, and toxicology. Procedures for obtaining copies of the translations are included. Author

N71-24763# Harvard Univ., Cambridge, Mass.

POTENTIAL CONSEQUENCES OF EXPERIMENTATION WITH HUMAN EGGS

James D. Watson *In* Comm. on Sci. and Astronaut. (U. S. House) Intern. Sci. Policy Feb. 1971 p 149-161 refs (See N71-24751 13-34)

Avail: SOD $0.75

The aspects of human embryogenesis and population control are analyzed in detail by considering test tube growths of human eggs and human clonal reproduction. It is desirable that as many people as possible are informed about the new ways of human reproduction and their potential consequences so that a formal legislative level can be reached about the many problems that are bound to arise if test tube conception becomes a common occurrence. Some form of international agreement is absolutely necessary before the possibility of having a free choice in human reproduction is gone. G.G.

N71-24889# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.

BIOLOGY AND HEALTH PHYSICS DIVISION PROGRESS REPORT, 1 APRIL - 30 JUNE 1970

30 Jun. 1970 52 p refs

(AECL-3728; PR-B-86) Avail: AEC Depository Libraries; Atomic Energy of Can., Ltd., Chalk River: $1.50

The research and routine monitoring activities of the Biology and Health Physics Division of AECL for the period of April 1 to June 30, 1970 are summarized. The various branches within the division and their major areas of study include: Biology Branch; biochemical and molecular studies, and developmental and population genetics studies; Environmental Research Branch; biological and physical studies, meteorological studies, chemical studies, and soil studies and radiochemical analysis. Health Physics Branch; dosimetry, detector, and monitoring instrumentation studies. The economic importance to AECL of the seasonal and geographic variations in the deuterium content of Canadian waters is discussed by the division director. NSA

N71-24931*# Stanford Research Inst., Menlo Park, Calif.
RESEARCH STUDY OF A FUNDUS TRACKER, PHASE 2 Final Report 18 Jan. 1968 – 1 Feb. 1971
D. H. Kelly and H. D. Crane Jan. 1971 45 p refs
(Contract NAS2-3995; SRI Proj. 6319)
(NASA-CR-114307) Avail: NTIS CSCL 06P

A stabilization technique based on tracking the edge of a blood vessel in the optic disk is described. A small spot of blue light is imaged on the fundus, and scanned in a circle around the optic disk at high speed. Variations in reflectance along this circular raster are detected by a photomultiplier tube and digitized for further processing. A selected frame of this digital video signal is stored in a magnetic-core array and correlated with subsequent frames to generate eye-movement information in real time. The correlation algorithmm distinguishes horizontal, vertical, and torsional motions of the fundus pattern. Analog displacement signals fed back to a servo-mechanism can thus cause the raster to track the fundus pattern, locking to the position of the selected frame. Such closed-loop signals can be used simultaneously to move a stimulus pattern in stabilized-image experiments. Author

N71-24953# School of Aerospace Medicine, Brooks AFB, Tex.
PARAMETER IDENTIFICATION AS AN AID TO MODELING RESPIRATORY SINUS ARRHYTHMIA Final Report, Sep. 1968 – Aug. 1970
Eric D. Grassman Dec. 1970 21 p refs
(AD-719860; SAM-TR-70-81) Avail: NTIS CSCL 6/19

A parameter identification scheme utilizing linear programming developed by Reid and Mackay has been applied to modeling the transient heart rate response to short-term respiratory maneuvers. The method was developed specifically for identification of physiologic control mechanisms, and it is especially useful in modeling short-term transient responses due to steplike forcing functions. Parameters of linear heart rate-respiration models have been identified, and the response of the models to training data closely resembles the experimental response. This type of approach, in conjunction with empirical data of other physiologic studies, may yield important information on the mechanism and quantitative relationships involved in the dynamic heart rate response to respiration. Author (GRA)

N71-24997# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HOMEOSTASIS IN WEIGHTLESSNESS
B. B. Egorov 2 Nov. 1970 17 p Transl. into ENGLISH from Proc. of 21st Intern. Astronautical Congr., Constance (USSR), 4 – 10 Oct. 1970 p 1 – 14
(AD-719790; FTD-HT-23-777-70) Avail: NTIS CSCL 6/19

The effect of absence of gravity on regulatory reflexes is discussed from the point of view of a typical cardiovascular and uretic functioning observed in cosmonauts. Author (GRA)

N71-25035*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN AUTOMATED LUCIFERASE ASSAY OF BACTERIA IN URINE
G. L. Picciolo, B. N. Kelbaugh, E. W. Chappelle, and A. J. Fleig Apr. 1971 24 p refs
(NASA-TM-X-65521; X-641-71-163) Avail: NTIS CSCL 06P

A method is described for the direct cell count of bacteria in urine specimens based on the bioluminescent reaction of luciferase when mixed with ATP. Comparative tables are presented of the results obtained from selected urine samples by the ATP assay and those obtained by culture-colony count and by the pour plate technique. These results demonstrate that the number of bacteria calculated by ATP measurements is much higher than by the other two methods. In addition, the design and operation of an automated instrument is described which performs the ATP assay in 15 minutes. After the luciferase is injected into a specimen, the vial passes in front of a photomultiplier-amplifier system that detects any light emitted and converts this light into a signal to a strip-chart recorder. The readout is a peak showing the amount of light emitted from the specimen, the height of the peak correlating to the amount of ATP, and thus to the amount of bacteria in the specimen. D.L.G.

N71-25146# Royal Aircraft Establishment, Farnborough (England).
IMPULSE LEVEL (MANIFEST ANXIETY) AND THE RECOGNITION OF PERIPHERALLY INTRODUCED VISUAL STIMULI AGAINST A MOVING BACKGROUND [TRIEBNIVEAU (MANIFESTE ANGST) UND DAS ERKENNEN PERIPHER EINGEFUEHRTER OPTISCHER REIZE UNTER DEM EINFLUSS EINES BEWEGTEN HINTERGRUNDES]
Werner D. Froehlich Jan. 1971 20 p refs Transl. into ENGLISH from Z. Exp. Angew. Psychol., v. 12, no. 4, 1965 p 570 – 584
(RAE-LIB-TRANS-1552) Avail: NTIS

From a group of 108 test personnel of ages between 18 and 26 the 12 most anxious and the 12 non-anxious (A and NA) subjects were chosen. Tests were made as to whether, for the group as a whole, movement of the background caused a narrowing of the field of view, that is, a later recognition of pheripherally introduced stimuli. This assumption was established. It was found in this connection that the shape of the figures of the pheripheral stimuli introduced had a decisive affect on the recognition. Changes or distinctions in the case of A and NA could not be shown with confidence, although two plausible hypotheses are available. Author

N71-25240*# Georgetown Univ., Washington, D.C.
THE MAGNETIC FIELD COMPONENT OF THE NEURAL IMPULSE Final Report
John H. Seipel [1970] 13 p refs
(Grant NGR-09-009-005)
(NASA-CR-118334) Avail: NTIS CSCL 06C

The existence of electric and magnetic field components possibly associated with the transmission of neuronal impulses was studied in isolated bullfrog sciatic nerves. The existence of the electric component was easily confirmed. Using detectors sensitive only to magnetic fields, a magnetic component could not be detected at a level equivalent to 0.9 microampere of 5 KHz current. Theoretical analyses of the sodium ion flows associated with the transmission of impulses in these nerves are presented. The absence of a signal at this detectability limit suggests that at least 99.8% of the sodium ion flux conforms to the local circuit theory. It is, however, not possible to conclude that a magnetic impulse, albeit small, does not exist since the confidence level of these experiments is a factor of 1000 greater than the signal predicted from the local circuit theory. Author

N71-25241# California Univ., Berkeley. Lawrence Radiation Lab.
MEASUREMENT OF OXYGEN EFFECT AND BIOLOGICAL EFFECTIVENESS OF A 910 MeV HELIUM ION BEAM USING CULTURED CELLS (T-1)
Mudundi R. Raju, Madhvanath Gnanapurani, Bambino Martins, Jerry Howard, and John T. Lyman Nov. 1970 13 p refs Presented at 63d Natl. Meeting of the Am. Inst. of Chem. Engr., Chicago
(Contract W-7405-eng-48)
(UCRL-20190; CONF-701103-7) Avail: NTIS

The depth-dose distribution of a 910-MeV monoenergetic helium ion beam is modified by using a ridge filter in the beam path so that the region of maximum dose is uniform over a distance of about 6 cm of water. The biological effectiveness and oxygen enhancement ratio (OER) at different depths within a rectangular Lucite phantom were measured by using cultured human kidney cells (T-1). The results indicate that the biological effectiveness at the broad peak region is about 1.3 to 1.4 compared with that at the beam entrance, and the OER is found to be about 1.7 to 1.9. This significant reduction in OER even when the beam

is modified to cover 6 cm of tissue may be of radiotherapeutic interest in treatment of deep seated tumors containing hypoxic cells.
Author (NSA)

N71-25326*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE BRAIN AS A MODEL FOR LSI
James S. Albus *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 292-294 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 06P

Component connection schemes of the brain and the resulting data processing capabilities are studied. Visualized are cells with variable strength independent x inputs; if a coincidence occurs between an x2 pulse and a pulse appearing on the in line of the cell, only the x2 connection is charged and all other connections remain unaffected. Connecting these cells into a planar array constitutes a trainable feedback control system model; the system can be trained by a pilot and probably substituted for a human pilot under flight conditions.
G.G.

N71-25393*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
HUMAN ACCLIMATION AND ACCLIMATIZATION TO HEAT A Compendium of Research
John E. Greenleaf and Carol J. Greenleaf Dec. 1970 191 p refs
(NASA-TM-X-62008) Avail: NTIS CSCL 06S

Studies of the mechanisms of short term acclimatization and acclimation to heat are discussed. Additional studies are included that provide background information in the form of reviews or classic descriptions of the process. Wherever possible a detailed annotation is provided under the subheadings: (a) definition of acclimation or acclimatization; (b) purpose of the study; (c) subjects used; (d) environmental conditions; and (e) results and conclusions. The abstracts cover material through December 1967. The abstracts are listed in alphabetical order by first author and an index is provided. Additional references are provided in the bibliography.
Author

N71-25438# Oak Ridge National Lab., Tenn.
IONIC CONDITIONING OF AIR
C. G. Invernizzi 1970 15 p refs Transl. into ENGLISH from Proceedings of Conf. on Isotope Radiation Techniques in the Building Industry (Brussels), 28-30 Oct. 1970 Sponsored by AEC
(ORNL-tr-2427; CONF-701027-2) Avail: NTIS

A review of air ionization and the effects of positive ions in air on man is presented. Information is included on the relations of ionization with pollution of air and the therapeutic properties of ionized air. A method of ionizing air using Am-241 sources is described in which electronically positive ions are collected and repelled by their unipolar charge resulting in a fan-shaped spread area: A selection method is used to emit negative ions into ambient air. If such devices are used in conditioned air they establish equilibrium, and if used in polluted air they promote precipitation of pollutants.
NSA

N71-25551# Oak Ridge National Lab., Tenn.
BASIC AND MISSION RESEARCH IN THE BIOLOGICAL SCIENCES AT ORNL
Peter Mazur Nov. 1970 120 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3218) Avail: NTIS

An analysis of biological research conducted at a military research facility is presented. The subjects discussed are: (1) methods for obtaining support for research projects, (2) effectiveness of communicating mission accomplishments, (3) justification for basic research and research personnel, and (4) potential contributions of scientific personnel in areas outside their immediate research specialties.
P.N.F.

N71-25559 Defence Research Establishment Toronto, Downsview (Ontario).
GUIDE TO NOISE HAZARD EVALUATION
Stanley E. Forshaw Nov. 1970 43 p refs *Its* Rev. Paper No. 771
Copyright. Avail: Issuing Activity

Damage risk criteria for steady state and impulse or gunfire noise are summarized. Information is compiled on: the ISO noise rating number for a continuous noise; the relationship between octave band sound pressure levels measured with standardized filters; the power addition of noise bands expressed in decibels; and noise interference effects on face-to-face speech communications in terms of A-weighted sound pressure levels. Also discussed are: calculation of an equivalent A-weighted sound pressure level from octave band sound pressure levels; maximum allowable daily exposure to continuous noise; intermittent steady state noise exposure; hearing protection device attenuation characteristics; peak overpressures in PSI and peak sound pressure levels in dB; and hearing conservation guidelines for certain weaponry.
E.C.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N71-24411# Army Test and Evaluation Command, Aberdeen Proving, Md.
OXYGEN AND PROTECTIVE MASKS (AVIATION) Final Report
25 Jan. 1971 27 p refs
(AD-719105; MTP-7-3-086) Avail: NTIS CSCL 6/11

Procedures are described for evaluating the suitability of oxygen and protective masks in an aviation environment.
Author (GRA)

N71-24412# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
APPLICATION OF RADIOISOTOPES TO WATER RECOVERY SYSTEM FOR EXTENDED MANNED AEROSPACE MISSIONS Final Report, Apr. 1968-Mar. 1970
Courtney A. Metzger Aug. 1970 24 p refs
(AD-718965; AMRL-TR-70-31) Avail: NTIS CSCL 6/11

Research conducted to obtain a process and system design for the recovery of potable drinking water from human waste during extensive space flights revealed that the most promising process required considerable thermal energy for satisfactory operation. The large consumption of electrical energy prohibits system acceptability when the energy drain is on the vehicle electrical supply system. To meet the need for thermal energy, radioisotopes were investigated and found to conform with the known requirements. The review of previous research on water recovery systems, the design and development of the Air Force modified system, and detailed data on two (36 and 39 day) tests with the isotopes in place supplying the total thermal energy is presented in the report. The complex system is considered a technological breakthrough and for the first time, a radioisotope fueled system is programmed for a 90-day manned chamber test, recovering drinking water from human waste for consumption by four crewmen during the experiment.
Author (GRA)

N71-24413# Texas Univ., Austin. Electronics Research Center.
CAPACITIVE ELECTROCARDIOGRAPH ELECTRODES
Henry Grady Rylander, III, P. C. Richardson, H. L. Taylor, and F. B. Vogt 4 Sep. 1970 123 p refs
(Grant AF-AFOSR-1792-69)
(AD-718958; AFOSR-70-2431TR; TR-99) Avail: NTIS CSCL 6/2

A discrete capacitive electrode system and a hybrid capactive sensor system were constructed and evaluated. Most of the fundamental characteristics of capactive electrodes were ascertained with a discrete component system because all of the system parameters could be varied easily. A hybrid capacitive sensor system evolved as the optimized version of the discrete capacitive electrode system. The principal component of all the capacitive electrodes was a silicon-silicon oxide half-capacitor. The half-capacitor and the skin formed a capacitor when the capactive electrode was pressed against the skin. The effective capacitance formed by the discrete capacitive electrodes and human skin was large enough to obtain adequate low-frequency response when large amplifier input resistances were used. Author (GRA)

N71-24414# Texas Instruments, Inc., Dallas. Equipment Group.
ADVANCED SURVIVAL AVIONICS DEVELOPMENT STUDY Final Report, Aug. 1969 – Mar. 1970
Charles F. Whistler, John P. Aasterud, Richard L. Clark, and Wayne M. Hoover Wright-Patterson AFB, Ohio SD Sep. 1970 117 p refs
(Contract F33657-70-C-0213)
(AD-715310; TI-07-968500-07; ASD-TR-70-27) Avail: NTIS CSCL 6/7

The gross system parameters for post-1975 Search and Rescue (SAR) avionics equipment were developed through a synthesis procedure that combined the results of surveys conducted with personnel engaged in various phases of SAR activities, a statistical investigation of SAR operations, and knowledge of the state of present and developing technology. One of the major conclusions reached was that the gross system parameters must be specified with respect to lowering the probability that the total SAR mission time will exceed two hours. Recommended parameters applicable to a system serving both combat and noncombat military SAR missions as well as civilian SAR missions included: a continuous world-wide distress monitoring system operating on 121.5 MHz and providing one- to two-mile position accuracy, a homing beacon with a 25-mile range operating on 121.5 MHz, and automatic activation of the signaling device(s). Additional features required for combat SAR missions included: voice communications on 243 MHz, nonOvoice identification capability, and covert signaling facility. The primary design emphasis for personal equipment should be placed upon reliability and ease of operation. Author (GRA)

N71-24453# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
HUMAN FACTORS Final Report
11 Dec. 1970 25 p refs
(AD-719108; MTP-7-3-510) Avail: NTIS CSCL 5/5

Human factor considerations applicable to aviation armament and avionics are described. Author (GRA)

N71-24455*# Whirlpool Corp., St. Joseph, Mich. Life Support Systems Group.
ZERO GRAVITY CLOTHES WASHER Final Report
John J. Symons Feb. 1971 26 p
(Contract NAS9-10934)
(NASA-CR-114983) Avail: NTIS CSCL 06K

The design, development, fabrication, and testing of an approximate half-scale demonstration model of a clothes washer is submitted. It utilizes principles of fluidics to provide washing action, and has the capability to function under conditions of zero gravity. This unit demonstrates decreased weight and complexity as compared to washers with mechanically driven agitators. Reduction of the number of components results in higher reliability. Author

N71-24460# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
CLOTHING (AVIATION) Final Report
23 Dec. 1970 24 p refs
(AD-719106; MTP-7-3-087) Avail: NTIS CSCL 6/17

Test procedures are described to determine the degrees and forms of protection, and the relative comfort and functional performance of flight crew member clothing. Author (GRA)

N71-24606* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
PHONOCARDIOGRAM SIMULATOR Patent
John M. Keefer, inventor (to NASA) Issued 28 Apr. 1970 (Filed 19 Dec. 1967) 5 p Cl. 35-17; Int. Cl. G09b23/28
(NASA-Case-XKS-10804; US-Patent-3,508,347; US-Patent-Appl-SN-691909) Avail: US Patent Office CSCL 06B

A device for producing electrical voltage waves that simulate the sounds of a human heart is described. This device is used to calibrate phonocardiograms. Block and schematic drawings of the device are submitted. Official Gazette of the U.S. Patent Office

N71-24623* United Aircraft Corp., East Hartford, Conn. Hamilton Standard Div.
OMNIDIRECTIONAL JOINT Patent
Michael A. Marroni, John C. Hardy, and Mark E. Baker, inventors (to NASA) Issued 23 Jun. 1970 (Filed 7 Oct. 1966) 5 p Cl. 2-21; Int. Cl. B63c11/04 Sponsored by NASA
(NASA-Case-XMS-9635); US-Patent-3,516,091; US-Patent-Appl-SN-586329) Avail: US Patent Office CSCL 06Q

A cord restraint system for pressurized suits includes axially spaced circumferential convolute roots spaced about the axis of rotation of a limb which carry a plurality of restraint sets. Each set includes a cord movable relative to points of attachment which extend from points above and below the bending axis and are pairs each of which are diametrically opposed on the respective convolute roots and each pair being circumferentially spaced 90 deg from each other. The cord is serially laced through each point of attachment. Official Gazette of the U.S. Patent Office

N71-24684# Jodon Engineering Associates, Inc., Ann Arbor, Mich.
APPLICATION OF CINEHOLOMICROGRAPHY TO THE STUDY OF MICROCIRCULATION HEMODYNAMICS Final Report, 1 Feb. 1968 – 31 Dec. 1970
Gary A. Vander Haagen and Dana E. Whitlow Feb. 1971 85 p refs
(Contract N00014-68-C-0433)
(AD-719401) Avail: NTIS CSCL 6/12

Instrumentation was developed for the study of microcirculation hemodynamics and related physiological studies of man and animal. Developed was a complete cineholomicrographic recording and playback system capable of producing holomicrographs of biological specimens at rates up to 50 frames per second on 35mm film. Key system features include a 1.2 micron resolution over the full 3mm by 3mm by 10mm field, use of a high power pulsed argon laser for high speed or time differential holography, high accuracy 35mm film transport for continuous ultra-low jitter recording and playback, delay line assembly for reduction of the laser speckle coherence problem, a fully articulated three-axis microscope system for viewing the reconstructed image, and provision for mounting a 16mm movie camera on the microscope for recording the reconstructed image. Author (GRA)

N71-24710*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

HUMAN RESPONSE IN CLOSED LOOP CONTROL OF DYNAMIC SYSTEMS
James J. Adams *In its* Performance and Dyn. of Aerospace Vehicles 1971 p 555-577 refs (See N71-24701 13-31)
Avail: NTIS HC $9.00/MF $0.95 CSCL 05E

A description is given of a model matching method which was used to determine human response in controlling a wide range of vehicles. The use of the resulting models of human response to determine the complete pilot plus vehicle system response is discussed. The implications of the results on system performance are discussed, and several examples in which the answers to engineering problems are obtained are presented. Author

N71-24727 Rutgers Univ., New Brunswick, N.J.
THE VISUAL PERCEPTION OF ACCELERATED MOTION
John Frederic Schmerler (Ph.D. Thesis) 1969 159 p
Avail: Univ. Microfilms Order No. 70-10099

Research was undertaken to answer three interrelated questions in regard to how people perceive changes in the rate of motion: (1) why are acceleration and deceleration difficult to perceive, (2) how is the perception of deceleration different from the perception of acceleration, and (3) what are the perceptual processes underlying the perception of motion changes. Five separate experiments were performed using filmed stimulus material, and a variety of response measures, including both categorical judgments and reproductive techniques. Thresholds for perceived motion changes were determined using different ratios of terminal to initial velocity (velocity ratio) for a given rate of acceleration or deceleration, as the independent variable. A brief summary of each experiment is presented. Dissert. Abstr.

N71-24728* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EXTRAVEHICULAR TUNNEL SUIT SYSTEM Patent
Joseph J. Kosmo and Elton M. Tucker, inventors (to NASA) Issued 3 Nov. 1970 (Filed 12 Sep. 1969) 6 p Cl. 244-1; Int. Cl. B64g1/00
(NASA-Case-MSC-12243-1; US-Patent-3,537,668; US-Patent-Appl-SN-857445) Avail: US Patent Office CSCL 06K

An extravehicular human work station permitting manual operation in a hostile environment is described. The work station consists of a semi-anthropomorphic assembly attached to the distal end of a tunnel extending from a vehicle wall. The tunnel is of convoluted bellows construction and may be selectively axially expanded or contracted by a system of individually controlled cables. The cables may be operated individually also in order to regulate the angle from which the tunnel axis projects from the vehicle wall.
Official Gazette of the U.S. Patent Office

N71-24729* Baylor Univ., Houston, Tex. Coll. of Medicine.
EEG SLEEP ANALYZER AND METHOD OF OPERATION Patent
James D. Frost, Jr., inventor (to NASA) Issued 22 Dec. 1970 (Filed 4 Feb. 1970) 11 p Cl. 128-2.1; Int. Cl. A61l5/05
Sponsored by NASA
(NASA-Case-MSC-13282-1; US-Patent-3,548,812; US-Patent-Appl-SN-8498) Avail: US Patent Office CSCL 06B

An apparatus and method for quantitatively measuring brain activity as an automatic indication of level consciousness is described. Amplitude weighted signals representative of frequency of brain activity are generated and combined to produce a level of consciousness output signal, which signal may be monitored and recorded. Official Gazette of the U.S. Patent Office

N71-24730* United Aircraft Corp., East Hartford, Conn.
FORESHORTENED CONVOLUTE SECTION FOR A PRESSURIZED SUIT Patent
Michael A. Marroni, Jr., inventor (to NASA) Issued 3 Nov. 1970 (Filed 20 Dec. 1968) 5 p Cl. 2-2.1; Int. Cl. A62b17/00
Sponsored by NASA
(NASA-Case-XMS-09837-1; US-Patent-3,537,107; US-Patent-Appl-SN-785710) Avail: US Patent Office CSCL 06Q

A procedure for constructing pressure suits with an improved convolute section to provide a high degree of mobility is described. A cloth convolute section is provided with extra material so that large angles of flexure may be obtained by foreshortening the lateral restraints on each side of the joint.
Official Gazette of the U.S. Patent Office

N71-24738* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SKELETAL STRESSING METHOD AND APPARATUS Patent
Wayne H. Howard and Donald R. Young, inventors (to NASA) Issued 29 Dec. 1970 (Filed 6 Feb. 1969) 8 p Cl. 128-24; Cl. 128-25; Int. Cl. A61h1/00
(NASA-Case-ARC-10100-1; US-Patent-3,550,585; US-Patent-Appl-SN-797058) Avail: US Patent Office CSCL 06B

A method and apparatus for applying a predetermined force to the lower leg of a subject experiencing prolonged recumbency or weightlessness are discussed. The subject's foot is placed in a stirrup or shoe means which is connected directly to the rack of a rack and pinion apparatus. A knee plate is also connected to the rack and pinion device by suitable cable means or the like so that by applying a predetermined torque to the pinion a compressive force is applied to the lower leg of the subject between the ankle and knee so as to simulate the forces to which this portion of the leg is normally subjected during ambulation.
Official Gazette of the U.S. Patent Office

N71-24747# Civil Aeromedical Inst., Oklahoma City, Okla.
PHYSIOLOGICAL RESPONSES IN AIR TRAFFIC CONTROL PERSONNEL: O'HARE TOWER
C. E. Melton, Jr., J. M. McKenzie, B. David Polis, G. E. Funkhouser, and P. F. Iampietro Jan. 1971 17 p refs
(FAA-AM-71-2) Avail: NTIS

Physiological and biochemical measurements were made on 22 air traffic controllers at O'Hare tower during five days of the heavy traffic evening shift (1600-2400) and five days of the light traffic morning shift (0000-0800). Pulse rates were higher on the evening shift than on the morning shift. Converging approaching traffic was more excitatory than departing diverging traffic on the evening shift; there was no differential response on the morning shift. Galvanic skin response indicated that adaptation to the morning shift was incomplete in five days. Fibrinogen levels in controllers' blood was not elevated above the expected level for their age group. Controllers had a higher total plasma phospholipid concentration than populations of normal people, schizophrenics and combat pilots. Phosphatidyl glycerol was significantly higher in controllers' plasma than in the normal population but less than in the combat and schizophrenic populations. Findings from urine analyese that are reported separately by Hale, et al., have been summarized in this report. Urine chemistry shows that catecholamine excretion is related to the number of aircraft operations. Corticoid excretion rises late in the morning shift and recovery from morning shift work is incomplete during the off-duty rest period. Author

N71-24748# Civil Aeromedical Inst., Oklahoma City, Okla.
USE OF SKIN TEMPERATURE TO PREDICT TOLERANCE TO THERMAL ENVIRONMENTS
P. F. Iampietro Jan. 1971 9 p refs
(FAA-AM-71-4) Avail: NTIS

Skin temperature is a sensitive index of the effect of the thermal environment on the seminude man. Skin temperatures and tolerance times for several studies have been utilized in an attempt to establish a relationship between (1) final skin temperature and tolerance time and (2) skin temperature during the early minutes of exposure and final skin temperature. The number of subjects

during each exposure ranged from five to ten. Exposure temperatures ranged from −4 deg to 113 C. (25 to 235 F.). Air movement ranged from about 50 to 880 ft/min. A relationship exists between final temperature and tolerance time and between final skin temperature and skin temperature at ten minutes of exposure. Final skin temperature (at tolerance) in hot and cold environments can be predicted from the skin temperature at ten minutes. Tolerance time may also be estimated from the ten minute skin temperature. Author

N71-24955# Grumman Aerospace Corp., Bethpage, N.Y. Life Sciences Section.

THE EFFECT OF AN EXPLICIT RESPONSE REQUIREMENT ON VIGILANCE PERFORMANCE

S. Klier and R. Pain May 1971 19 p refs

(RM-505) Avail: NTIS

During an 80-minute vigil, subjects in four groups responded to an intensity difference between two successively illuminated lights. Two factors were investigated: (1) high (1700) versus low (400) rates of stimulus presentation; and (2) an additional response to all stimuli as well as signals (active) versus response only to signals (passive). The active condition represented an attempt to demonstrate an explicit observing response connected with signal detection. Results showed significantly better detection for the low rate condition and a nonsignificant tendency for better performance for the active condition. There was no evidence for the coincidence of missed signals and inappropriate additional responses. The results are interpreted in terms of a reinforcement of observing response theory and are related to problems of motivation during long term monitoring. Author

N71-25000*# School of Aerospace Medicine, Brooks AFB, Tex. Environmental Sciences Div.

FLUID BALANCE IN ARTIFICIAL ENVIRONMENTS: ROLE OF ENVIRONMENTAL VARIABLES

William M. Carleton and B. E. Welch 2 Apr. 1971 240 p refs

(NASA Order T-74393-G)

(NASA-CR-114977) Avail: NTIS CSCL 06K

The influences of the most critical environmental parameters on fluid balance and on subjective and objective tolerance to the artificial environment are investigated. Ambient temperature, water vapor pressure, total barometric pressure, wind velocity, and atmospheric gas composition are examined from the following areas of human survival and function: insensible water losses and their skin, respiratory, and metabolic components; overall fluid and weight balance, and routes of fluid intake and output; and development of signs and symptoms related to environmental intolerance. The possible mediating roles of other environmental or physiologic variables are also reviewed. Author

N71-25001*# Whirlpool Corp., St. Joseph, Mich. Life Support Systems Group.

DEVELOPMENT OF COMPRESSED NONSWEET, FLAVORED SNACK FOODS TO BE USED IN THE APOLLO FOOD SYSTEM Final Report, 5 Jan. 1970 - 30 Apr. 1971

Robert W. Larson 30 Apr. 1971 17 p

(Contract NAS9-9032)

(NASA-CR-114996) Avail: NTIS CSCL 06H

The development of several flavored snack cube items based on the cheese cracker formulation is described. The formulations were compressed, coated, freeze dried, and evaluated for flavor, texture, and appearance. A part of each acceptable formulation was stored for 3 hours at 135 + or − 5 F, and a part for four weeks at 100 + or − 5 F. Samples of stored and unstored cubes were compared. Pizza, chicken, bacon, barbecue, ham and swiss, parmesan, and blue cheese flavors were selected for initial formulation, and samples of the last four were submitted to NASA for evaluation. N.E.N.

N71-25086# School of Aerospace Medicine, Brooks AFB, Tex.

METHOD FOR ASSESSING A-WEIGHTED AUDITORY RISK LIMITS FOR PROTECTED EARS Final Report, May - Oct. 1970

Donald C. Gasaway and Harrell C. Sutherland, Jr. Jan. 1971 17 p refs

(AD-719861; SAM-TR-71-1) Avail: NTIS CSCL 6/10

Recent noise exposure studies employ A-weighted measures as the basis for estimating varying degrees of potential auditory risk. Since most auditory risk criteria are based on unprotected exposures, aerospace applications require adapting the criteria to attenuated conditions. The report provides specific guidance for evaluating conditions of noise exposure when personal ear protection is worn (headsets or earplugs). Generalized spectra are presented for noise measured within cockpits of 249 aircraft divided into eleven groups, each representing a different airframe-to-powerplant mating. A-weighted levels for attenuated and nonattenuated noise are shown for each of the eleven groups of aircraft included in this study. Relationships between C- and A-weighted values for different spectra (octave bands) are described, and the use of C--A as a correction factor is evaluated. Author (GRA)

N71-25087# Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

DEVELOPMENT OF TRACKING ERROR FREQUENCY RESPONSE FUNCTION AND AIRCRAFT RIDE QUALITY DESIGN CRITERIA FOR VERTICAL AND LATERAL VIBRATION Final Report, 1 Jan. 1969 - 1 Aug. 1970

John W. Rustenburg Jan. 1971 92 p refs

(AD-719754; ASD-TR-70-18) Avail: NTIS CSCL 5/10

The report presents the results of a study of available experimental literature in order to more clearly define the shape of frequency response functions for human psychomotor performance under vertical and lateral vibration conditions. The performance frequency response functions as developed are based on a constant tracking error and are used in the calculation of a human performance index for some aircraft. Evaluation of human performance index values and associated crew effectiveness estimates are used to determine ride quality criteria in terms of exposure time and crew tolerance levels for vertical, lateral, and combined-axes vibration inputs. A comparison was made of the shape of vertical and lateral performance curves derived in the study with vertical and lateral objectionable discomfort curves derived independently for commercial transport passenger ride quality criteria development. By allowing for soft seat versus hard seat responses, close general agreement in the shapes of the frequency response curves is noted. Author (GRA)

N71-25099# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

REGENERATION OF SPACESHIP CABIN ATMOSPHERES BY MEANS OF UNICELLULAR ALGAE

G. I. Meleshko 4 Nov. 1970 11 p refs Transl. into ENGLISH from Proc. of 21st Intern. Astronautical Congr., Constance, 4 - 10 Oct. 1970 p 1 - 8

(AD-719831; FTD-HT-23-776-70) Avail: NTIS CSCL 6/11

The development of air regeneration systems utilizing photosynthesis of unicellular algae appears feasible due to efficiency of current bioengineering systems used for Chlorella cultivation and possibility of assuring stable performance of the systems. The efficiency of cultivation procedures used at present is achieved first of all by re-use of the culture medium without its intermediate treatment in adjacent components of the system. Stability of the system is related to biological peculiarities of the biological material (population involving specimens of different age and high reproduction rate) and can be maintained by certain techniques. Author (GRA)

N71-25533*# Martin Marietta Corp., Denver, Colo.
MODIFICATION OF AN ASTRONAUT'S MOCK UP TOOL KIT Final Report
Victor A. DesCamp, Michael W. Hussey, Joseph A. Lenda, and Billy B. Taylor Apr. 1971 162 p
(Contract NAS8-26448)
(NASA-CR-103135; MCR-71-59) Avail: NTIS CSCL 05H

The development is described of astronaut support equipment for use on future missions involving inflight maintenance tasks. Several items of non-flight hardware were developed including an astronaut's tool kit and tools, a repair kit designed to seal leaks in fluid systems, and a fluid removal tool used in the repair of fluid systems. A demonstration test panel was built for inflight maintenance simulation tests using the equipment. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N71-24449*# Aerospace Corp., El Segundo, Calif. Lab. Operations.
SOLUBILITIES OF NH3, CO, CO2, AND SF6 IN LIQUID PROPELLANTS Technical Report, Jan. 1969 – Apr. 1970
Elfreda T. Chang, Nev A. Gokcen, and Talmadge M. Poston 1 Nov. 1970 26 p refs
(Contract F04701-70-C-0059)
(AD-718959; TR-0059(6210-10)-; SAMSO-TR-71-17) Avail: NTIS CSCL 7/4

The solubilities of gases at various temperatures and pressures in the following gas-liquid binary systems were investigated: Gaseous ammonia (NH3) in liquid hydrazine (N2H4), in monomethylhydrazine (MMH, N2H3CH3), and in unsymmetrical dimethylhydrazine (UDMH, 1, 1-N2 H2(CH3)2); gaseous carbon monoxide (CO) in liquid UDMH; gaseous sulfur hexafluoride (SF6) in liquid MMH, and in dinitrogen tetroxide (N2O4); and gaseous carbon dioxide (CO2) in N2O4. The solubilities of NH3 were found to obey Henrys law in the range of about 0 to 0.20 mole fraction. All other gases are much less soluble than NH3 and obey Henrys law at all concentrations. For each liquid, the standard Gibbs energy of solution of each gas has been expressed as a function of absolute temperature. Author (GRA)

N71-24607* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
APPARATUS FOR TESTING POLYMERIC MATERIALS Patent
Raffaele F. Muraca, inventor (to NASA) Issued 15 Dec. 1970 (Filed 11 Mar. 1968) 10 p Cl. 73-17; Int. Cl. G01n25/02 Sponsored by NASA
(NASA-Case-XNP-09699; US-Patent-3,546,920; US-Patent-Appl-SN-711972) Avail: US Patent Office CSCL 07D

An apparatus for determining the volatile condensable material present in polymeric products is described. It consists of a plurality of chambers which are controllably heated for holding the samples. Each chamber communicates with a removable plate controllably cooled so that condensables driven off from the polymeric material in the chamber will deposit and remain on the cooled plates. The entire apparatus is operated under a vacuum whereby the volatile noncondensable gaseous material driven off the samples is withdrawn from the system. Weighing of the plates before and after indicates the amount of volatile condensable material. One model for testing micro samples and another for testing large pieces of material are submitted. Official Gazette of the U.S. Patent Office

N71-24611*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
USE OF INCANDESCENT LAMPS TO MEASURE OPTICAL AND DETECTOR DRIFTS IN PHOTOELECTRIC SPECTROMETERS
Michael L. Franklin and William A. Gordon Washington May 1971 13 p refs
(NASA-TN-D-6313; E-6129) Avail: NTIS CSCL 14B

An evaluation of incandescent lamps as photometric reference devices in the measurement of drifts in photoelectric spectrometers is reported. The selected lamps are stable to better than 0.4 percent relative standard deviation for at least 1000 on-off cycles, each of 30 sec duration. This is equivalent to a use time of about 1 year in the dirft detection system. A procedure for routine monitoring of optical and detector drifts in spectrometers is suggested. The drift detection system provides an alternative way to correct drifts affecting analytical calibrations without the need to analyze standard samples. Author

N71-24726 Maryland Univ., College Park.
CATHODOLUMINESCENT PROPERTIES OF YVO4:Eu
James Michael McGarrity (Ph.D. Thesis) 1969 127 p
Avail: Univ. Microfilms Order No. 70-10287

The cathodoluminescence and other properties of the polycrystalline powder YVO4:Eu were investigated. The study was initiated because of the interest in materials used in kinescopes and in beta-excited self-luminous phosphors. The latter can be used in conjunction with a photovoltaic cell to form a double conversion battery. The strong emissions of YVO4:Eu in the red-infrared region and the strong response of silicon photo-cells in the same waveband offer a possibility of a relatively efficient low power source of electricity. The intrinsic efficiency of the cathodoluminescence process and other related properties of the powdered phosphor are reported as a function of wavelength. The principal measurements were made with electrons from a Van de Graff accelerator impinging on powdered YVO4:Eu targets oriented 45 deg to the incident beam. Dissert. Abstr.

N71-24739* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MODIFIED POLYURETHANE FOAMS FOR FUEL-FIRE Patent
John A. Parker and Salvatore R. Riccitiello, inventors (to NASA) Issued 22 Dec. 1970 (Filed 5 Feb. 1968) 5 p Cl. 260-2.5; Int. Cl. C08g22/44
(NASA-Case-ARC-10098-1; US-Patent-3,549,564; US-Patent-Appl-SN-702967) Avail: US Patent Office CSCL 07D

Flame retardant and flame suppressant materials are discussed. The main structure of the material is a rigid or semi-rigid polyurethane foam, preferably of a highly branched structure, in which are incorporated one or more materials to impart special properties. One of the added materials is an alkyl halide resin such as polyvinyl chloride which is capable of splitting off HCl and forming a polyene on heating. Other materials which may be, and preferably are, added are certain inorganic salts (e.g., potassium fluoborate) an encapsulated volatile halogen compounds such as trifluorotrichloroethane. Official Gazette of the U.S. Patent Office

N71-24740* Notre Dame Univ., Ind.
AROMATIC DIAMINE-AROMATIC DIALDEHYDE HIGH MOLECULAR WEIGHT SCHIFF BASE POLYMERS PREPARED IN A MONOFUNCTIONAL SCHIFF BASE Patent
Gaetano F. D'Alelio, inventor (to NASA) Issued 23 Jun. 1970 (Filed 9 Nov. 1966) 4 p Cl. 260-72.5; Int. Cl. C08g9/06 Sponsored by NASA
(NASA-Case-XMF-03074; US-Patent-3,516,971; US-Patent-Appl-SN-593595) Avail: US Patent Office CSCL 07D

Schiff base polymers having a repeating unit are prepared in tractable, fusible, high molecular weight form amenable to fabrication into useful articles by reacting an aromatic diamine with an aromatic dialdehyde having in a monofunctional Schiff base, which serves as a reaction medium and moderator. The reaction

mixture is heated slowly to 250 to 300 C to produce a fusible, black polymer. Heating to higher temperatures removes the monofunctional Schiff base and converts the polymer to an infusible material having a very high degree of thermal stability. Official Gazette of the U.S. Patent Office

N71-24918# Arkansas Univ., Fayetteville. Dept. of Chemistry.
SOLID PHASE SUBSTITUTION REACTIONS OF PALLADIUM(II) COMPLEXES
Dale A. Johnson and Walter H. Delphin [1971] 3 p refs Submitted for publication
(Grant NSF GP-8063)
Avail: Issuing Activity

During an investigation of the thermal and photochemical reactions of a number of square planar complexes, the complex chloroethylene diamine mu-aminoethyl ammonium palladium(II) chloride originally synthesized by others was investigated. In addition to spectroscopic evidence supporting the original assignment concerning the composition of the coordination sphere of the palladium(II) ion, the observation is reported of a solid phase displacement of the 2-aminoethylammonium ion ligand by a lattice chloride ion to form dichloro ethylene diamine palladium(II) and 2-aminoethyl ammonium chloride. Author

N71-24998# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.
[SOLID STATE, CHEMISTRY, AND MATERIALS RESEARCH]. CHEMISTRY AND MATERIALS DIVISION Progress Report, 1 Jul. - 30 Sep. 1970
30 Sep. 1970 108 p refs
(AECL-3776) Avail: AEC Depository Libraries; Atomic Energy of Can., Ltd., Chalk River: $2.00

Research projects in chemistry and metallurgy are described. Subjects discussed are: (1) crystal structure of aluminum alloys, (2) diffusion of calcium isotopes, (3) neutron capture cross sections for cobalt isotopes, (4) ion scattering in thin films, (5) burnup monitoring of reactor fuels, (6) radiation effects on monocrystal semiconductors, and (7) radiolysis of water vapor. Author

N71-25046# Massachusetts Univ., Amherst. Dept. of Chemical Engineering.
DYNAMICS OF pH CSTR'S
Thomas J. McAvoy, Elmer Hsu, and Stuart Lowenthal [1971] 14 p refs Submitted for publication
(Grant NSF GK-2982)
Avail: Issuing Activity

A method of deriving dynamic equations for pH CSTR's is presented. A specific example of neutralizing sodium hydroxide with acetic acid is discussed in detail. Experimental results on a laboratory sized CSTR verified the accuracy of the derived model. Author

N71-25047# Massachusetts Univ., Amherst. Dept. of Chemical Engineering.
TIME OPTIMAL AND ZIEGLER NICHOLS CONTROL EXPERIMENTAL AND THEORETICAL RESULTS
Thomas J. McAvoy [1971] 37 p refs Submitted for publication
(Grant NSF GK-2982)
Avail: Issuing Activity

Experimental and theoretical results for time optimal control of pH in a sodium hydroxide - acetic acid CSTR are presented. Reasonable agreement between theory and experiment is achieved. Discrepancies are the result of the exceptionally fast response of pH. A comparison of proportional plus derivative control and time optimal control shows that the former gives results which are near optimal. It is pointed out that a three mode controller is poor for comparison purposes because the integral control causes trouble. Some results for a second order dead time process are given which show that a proportional plus derivative controller can be close to time optimal for this case also. Author

N71-25081*# Cornell Univ., Ithaca, N.Y. Center for Radiophysics and Space Research.
LONG WAVELENGTH ULTRAVIOLET PHOTOPRODUCTION OF AMINO ACIDS ON THE PRIMITIVE EARTH
Carl Sagan and B. N. Khare Dec. 1970 16 p refs
(Grants NGR-33-010-082; NGR-22-010-101)
(NASA-CR-118329; CRSR-424) Avail: NTIS CSCL 07D

Amino acids are produced by irradiation of gas mixtures with long wavelength UV light, using hydrogen sulfide as the initial photon acceptor. The principal conclusions are the following: (1) Hydrogen sulfide is an acceptable long wavelength photon accepton. The 1849 A line is not necessary for the production of amino acids, but initial ethane is. Ethane is a likely product of electrical discharge and short wavelength UV irradiation of methane. Temperatures higher than plausible mean surface temperatures are not required. (2) A quantum yield of approximately .00005, and an efficiency number greater than 6 million amino acid molecules per erg are implied. Over a period of 10 to the 19th power years of UV irradiation of the early earth, this is the equivalent of 200 kg/sq cm of amino acids produced, a huge number suggesting congenial conditions for the origin of life. (3) Cystine and therefore perhaps other sulfur-containing amino acids can be produced in simulated prebiological conditions. Author

N71-25125# Royal Aircraft Establishment, Farnborough (England)
INVESTIGATION IN THE FIELD OF THE CHEMISTRY OF MOLYBDENUM. REPORT 2: A STUDY OF THE SIDE AND INTERMEDIATE REACTIONS OF MOLYBDENUM DISULPHIDE WITH CARBON DIOXIDE [ISSLEDOVANIE V OBLASTI KHIMII MOLIBDENA. SOOBSHCHENIE 2: IZUCHENIE POBOCHNYKH I PROMEZHUTOCHNYKH REAKTSII DISULFIDA MOLIBDENA S UGLEKISLYM GAZOM]
M. A. Samedov et al Jan. 1971 18 p refs Transl. into ENGLISH from Tr. Inst. Khim. Akad. Nauk Azerb. SSR (Baku), v. 13, 1954 p 21 28
(RAE-Lib-Trans-1494-Pt-2) Avail: NTIS

MoS2 reacts with SO2 at elevated temperatures to form MoO2 and free sulphur, as follows: MoS2 + SO2 = MoO2 + 3S. The reaction, which commences at about 800 C and proceeds to completion in about 3 h at 1100 C, may be regarded as a new method of preparing MoO2. It occurs both during the burning of molybdenite ores and in the reaction of MoS2 with CO2, since both of these reactions produce SO2. Carbon monoxide is unable to react with MoS2 even at temperatures of up to 1000 C, and this is attributed to the strength of the Mo-S bond. However, CO does inhibit the usual reaction of MoS2 and SO2 preferentially reacts with CO. The major reaction products of MoS2 and CO2 are MoO2 and SO2. Since MoS2 and MoO2 are known to react to form metallic molybdenum in accordance with 2MoO2 + MoS2 = 3Mo + 2SO2 then metallic molybdenum might be expected to be present in the reaction products of MoS2 and CO2. Its absence is attributed to the subsequent oxidation to MoO2 by either SO2 or CO2, both of which are present in the reaction atmosphere. No reaction was observed between SO2 and MoO2 at temperatures up to 1000 C. Author

N71-25137# Joint Publications Research Service, Washington, D.C.
ANALYSIS OF ORGANOPHOSPHOROUS COMPOUNDS BY GAS-LIQUID CHROMATOGRAPHY
L. S. Subbotina et al 7 Apr. 1971 8 p refs Transl. into ENGLISH from Zh. Anal. Khim. (USSR), v. 26, no. 2, 1971 p 364 - 368
(JPRS-53065) Avail: NTIS

A method for selecting and processing a solid carrier for organophosphorus compounds is discussed. Chemical modification of solid diatomic carriers, using hexamethyl disilazane, was used in gas liquid chromatography. The powder chrome of iodine, thus modified, was found to be as effective as the chrome sorbent. Conditions were selected for the qualitative and quantitative analysis of esters of phosphorus-III acids and amino phosphonates. The possibility of conducting qualitative analysis for amido esters was studied. Author

N71-25138# Royal Aircraft Establishment, Farnborough (England).
INVESTIGATIONS ON THE THERMAL COLOURATION OF POLYACRYLONITRILE [UNTERSUCHUNGEN ZUR THERMISCHEN VERFAERBUNG DES POLYACRYLNITRILS]
Joachim Ulbricht et al Nov. 1970 31 p refs Transl. into ENGLISH from Faserforsch. u. Textiltech. (Berlin), v. 20, no. 4, 1969 p 170-178
(RAE-Lib-Trans-1495) Avail: NTIS

The effect of structural and other parameters on the coloration of polyacrylonitrile has been investigated to confirm that an intramolecular cyclisation reaction of nitrile groups with the formation of a chromophore of conjugated C=N bonds is responsible for the thermal coloration. This reaction has no direct relationship with the pyrolysis of polymers which does not begin until a temperature of 250 C is reached. In the presence of air, at least two reactions are involved in the coloration. The main initiators of the coloration reaction are acid end groups and structural anomalies, e.g. ketene-imine bonds or their reaction products resulting from the termination of the polymerization reaction. Although the presence of oxygen is not necessary it has a strongly accelerating effect. Author

N71-25191# Chicago Univ., Ill. Dept. of Chemistry.
INTERACTIONS ON METALLIC SURFACES Progress Report, 1 Feb. 1970-1 Feb. 1971
Robert Gomer 1971 5 p refs
(Contract AT(11-1)-1383)
(COO-1383-11) Avail: NTIS

Work on three tasks is reviewed: (1) adsorption studies in the field ion microscope with argon imaging; (2) mass spectrometric desorption studies with emphasis on electron impact desorption of CO from the (110) plane of tungsten; and (3) energy distributions of field emitted electrons. E.C.

N71-25314*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A RESIDUAL GAS ANALYSIS TECHNIQUE FOR STUDIES OF PHOTOCHEMICAL SURFACE REACTIONS OF POWDERS
Joe A. Colony *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 249-252 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 07D

Ultraviolet degradation of white control coatings is studied by evaluating the absolute values of partial pressures developing during photodegradation of A1203 powder surfaces. Changes in partial pressure curves of the low mass species in a vacuum system indicate interaction of the radiation with the surface. Partial gas pressure curves on high purity alpha aluminum oxide exhibit a sharp oxygen decrease at the onset of irradiation, indicating photoadsorption and suggesting in turn very high sensitivity to adsorbed reducible materials. G.G.

N71-25348# Dow Chemical Co., Golden, Colo.
METHOD FOR PREPARING LOW CONCENTRATION STANDARD GAS SAMPLES
Daniel J. Fehringer 12 Feb. 1971 3 p ref
(Contract AT(29-1)-1106)
(RFP-1626) Avail: NTIS

A high precision method of preparing gas mixtures is described. Mixtures with concentrations as low as 10 parts per million can be readily prepared, as well as multicomponent mixtures. These gas samples serve as standards in the calibration of mass spectroscopy and gas chromatography equipment, and are prepared with accuracy traceable to national standards. Author (NSA)

N71-25349# Arkansas Univ., Fayetteville. Dept. of Chemistry.
SOLVENT EFFECTS IN THE SUBSTITUTION REACTIONS OF TRANS-Pt(C5H5N)2Cl2
Ronald N. Collins and Dale A. Johnson [1970] 22 p refs Submitted for Publication
(Grant NSF GP-8063)
Avail: Issuing Activity

The rates of nucleophilic substitution in trans-Pt(C5H5N)2Cl2 were determined as a function of solvent composition in dimethylsulfoxide (DMSO) and dimethylsulfoxide-water mixture. The results of these measurements combined with an investigation solvent isotope effect suggest that leaving group solvation, or some similar process involving hydrogen bonding, plays a kinetically important role in these reactions. For example, the second order rate constants for thiourea as a nucleophile are 0.64, 0.71, and 0.99 liter mole/1 sec/1 in DMSO and DMSO-D2O or DMSO-H2O containing 0.18 mole fraction of the aqueous component respectively. Author

N71-25364*# IIT Research Inst., Chicago, Ill. Technology Center.
SYNTHESIS OF SPACE STABLE POLYMERIC FILM FORMERS Final Report, 9 Jun. 1970-8 Jan. 1971
C. Giori Apr. 1971 71 p refs
(Contract NAS1-10092)
(NASA-CR-111884; IITRI-C6216-7) Avail: NTIS CSCL 07C

Several fluoroaromatic silicon and carbon polymers were synthesized and the effect of simulated solar ultraviolet and proton irradiation in a vacuum environment was determined. The polymers studied are the s-triazinyl polyethers, the polyaryloxysiloxanes, the polydiphenyl siloxanes and Phenyl T (ladder polyphenyl silsesquioxane). Methods of synthesis and thermal properties of these polymers are described. Perfluorinated polymer structures were successfully prepared. These polymers exhibit excellent stability to proton irradiation but are less stable to ultraviolet irradiation. It is suggested that the enhanced polarization of the carbon-silicon bonds due to the strong inductive effect of the perfluorophenyl groups is responsible for the relatively low ultraviolet and thermal stability of the perfluoroaromatic silicones. Author

N71-25385# Adelaide Univ. (Australia). Dept. of Physics.
PHOTOELECTRON SPECTROSCOPY AND PARTIAL PHOTOIONIZATION CROSS SECTIONS FOR IODINE AND BROMINE
J. H. Carver and J. L. Gardner [1971] 28 p refs
(ADP-101) Avail: NTIS

A hemispherical retarding potential analyzer was used in conjunction with a vacuum monochromator to record photoelectron spectra from iodine and bromine. The photoelectron spectra were recorded at wavelength intervals of 5A over the range from 584A to 1245A in the case of iodine and from 584A to 1180A in the case of bromine. Total photoionization cross sections for these molecules were measured over the same wavelength ranges using a double ion chamber technique. The relative populations of the electronic states resolved in the photoelectron spectra were combined with the total photoionization cross section measurements in order to determine the corresponding partial cross sections. Author

N71-25488# Sussex Univ., Brighton (England). Chemical Lab.
INORGANIC MASS SPECTROMETRY AND THERMOCHEMISTRY RELATED TO FUELS, STUCTURAL

MATERIALS AND POLYMERS Final Scientific Report, 1 May–30 Sep. 1970
Michael F. Lappert and J. Brian Pedley Dec. 1970 80 p refs
(Contract F610652-67-C-005)
(AD-719817; AFOSR-TR-71-0569) Avail: NTIS CSCL 7/3

The following chemical procedures are discussed. (1) Photoelectron spectroscopy of dimethyl aminohaloboranes; (2) 11B nuclear magnetic resonance data for the boron trihalides and mixed trihalides; (3) Mass spectrometric studies on compounds Me4M and Me3M-M (1)Me3 (M and M (1) = C, Si, Ge, Sn, and Pb); and (4) Metal-metal bond dissociation energies, raman and infrared spectra for the series (pi-C5H5)(CO)3M (1)M (2)Me3 (M(1)-Cr, Mo, or W; M (2) = Ge or Sn). The compounds investigated are simple derivatives of boron, carbon, and silicon and the other Group IV elements. Increased knowledge of basic thermodynamic parameters for such compounds is important in assessing the suitability of more complex compounds as fuels, structural materials, and inorganic polymers capable of withstanding exposure to high temperatures.
Author (GRA)

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N71-24357# IIT Research Inst., Chicago, Ill.
AVIONICS INTERFERENCE PREDICTION MODEL
G. Morgan Annapolis, Md. Electromagnetic Compatibility Analysis Center Nov. 1970 140 p refs
(Contract F19628-70-C-0291)
(AD-718997; ESD-TR-70-286) Avail: NTIS CSCL 20/14

An interference prediction model developed for use in evaluating expected interactions between avionics equipments on an airplane is described. The model is substantially automated and includes subroutines which calculate expected path losses between aircraft antennas and the rejection offered by the receivers to the undesired emissions from transmitters on the aircraft. An analysis of the interactions between the equipments installed on an FAA Sabreliner has been made using the prediction model and the results of the analysis are described. Requirements for expansion of the prediction model are established. Author (GRA)

N71-24361# Forschungsinstitut fuer Funk und Mathematik, Werthoven (West Germany).
GENERATION OF SIMULATED CLUTTER SIGNALS WITH KNOWN CORRELATION [DIE ERZEUGUNG VON SIMULIERTEN CLUTTERSIGNALEN MIT VORGEGEBENER KORRELATION]
H. Dannemann and E. Hanle Bonn Bundeswehramt 1970 38 p refs In GERMAN Sponsored by Bundesmin. fuer Verteidigung (BMVg-FBWT-70-7) Avail: NTIS; Bundeswehramt: 25 DM

The generation of clutter signals with auto and cross correlation, by means of simulation is described. The mathematical methods are outline for determining the weighting functions of a filter creating clutter signals with given correlation. The error arising from the finite number of correlation values available is calculated.
ESRO

N71-24362# Lincoln Lab., Mass Inst. of Tech., Lexington.
ELF PROPAGATION STUDY, PHASE 1, SUMMER 1970
David P. White and Donald K. Willim 11 Jan. 1971 56 p refs Sponsored in part by the Navy
(Contract F19628-70-C-0230)
(AD-718100; TN-1971-3; ESD-TR-71-4) Avail: NTIS CSCL 20/14

With the availability of an ELF transmitter (the Bravo test facility at Clam Lake, Wisconsin) it now becomes feasible to make far-field field strength measurements at the lower ELF frequencies. Field strength measurements were made in Hawaii and California at 45 and 75 Hz in an attempt to determine the east-west attenuation rate under daytime or nighttime conditions over the propagation path. As a result of high atmospheric noise conditions and a low transmitted power level, the relatively large uncertainty in signal estimates makes accurate estimation of alpha impossible. However, the data indicate a daytime east to west attenuation rate between 0.7 and 1.2 db/Mm and a nighttime rate between 1.0 and 1.8 db/Mm. Future experiments are being planned to refine the estimates of alpha to within plus or minus 0.2 db/Mm.
Author (GRA)

N71-24401# Northrop Corp., Palos Verdes Estates, Calif. Electronics Div.
DIGITAL ADDRESS THIN DISPLAY TUBE Quarterly Progress Report, 16 May–16 Aug. 1970
Walter F. Goede Ft. Monmouth, N.J. ECOM Feb. 1971 48 p
(Contract DAAB07-70-C-0110)
(AD-719282; NORT-70-353-2; ECOM-0110-2; QPR-2) Avail: NTIS CSCL 17/9

The report describes the progress to develop a 32x52 resolution-element digital address thin display tube for a man-pack radar. The parametric tradeoff and design studies initiated in the first period were continued, construction of a low-power area-cathode was initiated, testing of various dynode hole-geometries was completed, and the design of low-power electronics was initiated. The proposed dynode decoding structure is described in detail, and calculations of expected dynode contrast-ratio dynode power-dissipation, and brightness are presented. The test results of six dynode-geometries are presented, along with selection of the most desirable geometry. Initial results of the electronics design study are presented, and estimates of total power-dissipation are made. Author (GRA)

N71-24402# European Space Research Organization, Paris (France).
EUROPEAN SATELLITE PROGRAMME FOR TELEPHONY AND TELEVISION DISTRIBUTION Progress Report, Aug. 1970–Jan. 1971
Feb. 1971 56 p
(CSE/CS(71)1) Avail: NTIS

The present state of the ESRO project of a communication satellite serving television, telephone, telex, and data transmission requirements is described. The initial phase of programming, the present state of the project, relations with potential users, and action in industry are discussed. ESRO

N71-24416# Syracuse Univ., N.Y. Dept. of Electrical Engineering.
COMPUTER PROGRAMS FOR CHARACTERISTIC MODES OF BODIES OF REVOLUTION
Joseph R. Mautz and Roger F. Harrington Jan. 1971 69 p refs
(Contract F19628-68-C-0180)
(AD-718969; AFCRL-71-0014; SR-10) Avail: NTIS CSCL 20/14

Computer programs are given for calculating the characteristic currents and characteristic gain patterns of conducting bodies of revolution. Also given are computer programs for using these characteristic currents in aperture radiation and plane-wave scattering problems. Plot programs for use with a Calcomp plotter are included. Operating procedures and program details are discussed, and sample input-output data are given. Author (GRA)

N71-24417# RAND Corp., Santa Monica, Calif.
A MATHEMATICAL FOUNDATION FOR SELECTING RADAR LOCATIONS FOR OPERATIONAL TESTING OF INERTIAL SYSTEMS
John M. Bachar Dec. 1970 37 p ref
(Contract F44620-67-C-0045)
(AD-718967; RM-6288-PR) Avail: NTIS CSCL 17/9

The report is one in a series of memoranda exploring new techniques in ICBM testing and improvements in the test-range configuration. It contains the mathematical foundations for a computer program that determines the optimal locations of the radar trackers on a missile test range, such that a certain statistical estimate of miss, relative to the actual impact point, is minimized. The memorandum considers the problem of radar-tracking, during boost phase, a rocket vehicle navigated by an inertial measurement unit (IMU). If the maximum likelihood estimate of the IMU parameters that produced a given set of noisy range data is determined, and if the maximum likelihood estimate of miss is calculated from this parameter estimate, then the vehicle miss covariance matrix is a function of the radar map locations. The study presents an optimization scheme for locating the radars such that the maximum eigenvalue of the covariance matrix is minimized.
Author (GRA)

N71-24450# Aerospace Corp., El Segundo, Calif. Engineering Science Operations.
PCM PROCESSING OF BANDPASS SIGNALS Progress Report, May–Jul. 1970
Fred H. Shaver 13 Nov. 1970 34 p refs
(Contract F04701-70-C-0059)
(AD-718962; TR-0059(6472)-3; SAMSO-TR-71-39) Avail: NTIS CSCL 9/6

The process of sampling a bandpass analog signal, as is done in a PCM telemeter, and reproducing the analog signal by filtering a sequence of pulses introduces several types of errors in the output signal. Two of these types of errors, aliasing errors and flat topped sampling pulse errors, are uniquely dependent on the bandpass nature of the input signal. The characteristics of these errors are analyzed in terms of their spectrums. In particular, the dependence of the total power contributed by each type of error on the specific frequency band occupied by the signal investigated.
Author (GRA)

N71-24458# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
COMMUNICATION SECURITY EQUIPMENT Final Report
30 Dec. 1970 16 p refs
(AD-719095; MTP-6-3-D55(C)) Avail: NTIS CSCL 17/2

Procedures are described for testing communications equipment designed to provide secure communications under simulated tactical conditions. Operational intelligibility, system compatibility, reliable communication range, and electromagnetic effects are tested.
Author (GRA)

N71-24557# Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.
ALLEVIATION OF THE PLASMA BOUNDARY LAYER BY CHEMICAL INJECTION
Charles W. Haldeman and James P. McGuirk Dec. 1970 81 p refs
(Contract F19628-69-C-0043)
(AD-718976; SR-5; TR-12; AFCRL-71-0016) Avail: NTIS CSCL 20/14

Work performed on the transmission and radiation characteristics of antennas on the surface of a plasma-covered wind tunnel model is reported. The model S- Band signals at 50 percent or less additive mass fraction. Data from electrostatic probes is presented which indicates that the mechanism of alleviation is electron attachment to form heavy negative species. Teflon and carbon phenolic ablative plasmas were also studied and the effects of these ablative materials on the plasma sheath are presented. The effect of ultrasonic energy on small fluid jets was also studied, as was the penetration of these jets into the wind stream.
Author (GRA)

N71-24583* Hughes Aircraft Co., Los Angeles, Calif.
BROADBAND FREQUENCY DISCRIMINATOR Patent
Samuel Sabaroff, inventor (to NASA) Issued 6 Oct. 1970 (Filed 21 May 1968) 4 p Cl. 329-140; Int. Cl. H03d3/26 Sponsored by NASA
(NASA-Case-NPO-10096; US-Patent-3,533,001; US-Patent-Appl-SN-730700) Avail: US Patent Office CSCL 17B

A broadband frequency discriminator is disclosed which includes a pair of resistive-capactive-inductive (RCL) networks connected to parallel between an input terminal to which input signals are applied and grounded. The inductor of one network and the capacitor of the other are connected in parallel. The output voltage is produced by detecting and combining the voltages across the other non-parallel inductor and capacitor.
Official Gazette of the U.S. Patent Office

N71-24601# Army Test and Evaluation Center, Aberdeen Proving Ground, Md.
SURVIVAL RADIOS
4 Feb. 1971 17 p refs
(AD-719676; MTP-6-3-024) Avail: NTIS CSCL 17/2

Procedures are described for evaluating survival radios under typical crash conditions. Functional and environmental considerations are discussed.
Author (GRA)

N71-24612* Westinghouse Electric Corp., Huntsville, Ala.
SOLID STATE TELEVISION CAMERA SYSTEM Patent
Marvin A. Schuster, James C. Broderick, Carl T. Huggins, William F. List, Gene Strull et al. inventors (to NASA) Issued 30 Sep. 1969 (Filed 11 May 1966) 14 p Cl. 178-7.1; Int. Cl. H04n3/16 Sponsored by NASA
(NASA-Case-XMF-08092; SU-Patent-3,470,318; US-Patent-Appl-SN-550088) Avail: US Patent Office CSCL 09F

A solid state television camera system consisting of a monolithic semiconductor mosaic sensor and a molecular digital readout system is described. The readout circuit includes a timing and switching circuit for sequentially reading the output of each of the transistors in the mosaic and an output circuit for visually displaying the output of the mosaic sensor. The sensor is a M x N matrix of phototransistors interconnected by M common collector regions (rows) and N rows of connected emitters, so that any combination of one collector row and one emitter row will provide access to one phototransistor.
Official Gazette of the U.S. Patent Office

N71-24613* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DIGITAL SYNCHRONIZER Patent
Tage O. Anderson, inventor (to NASA) Issued 29 Dec. 1970 (Filed 10 Mar. 1969) 11 p Cl. 325-325; Int. Cl. H04b1/16; Int. Cl. H04l7/00 Sponsored by NASA
(NASA-Case-NPO-10851; US-Patent-3,551,816; US-Patent-Appl-SN-805406) Avail: US Patent Office CSCL 17B

A digital synchronizer provides a bit clock for use as a bit sync signal extracting binary data in a receiver of a PSK/PCM communication system. The synchronizer operates in the digital domain by summing digital samples produced from an analog noisy NRZ binary waveform which contains the data to be extracted. The samples are accumulated regarding sign, to form group sums which are then accumulated disregarding sign to provide sums of

multigroup observation periods. The phase of the observation period having the largest digital value is used to obtain the phase of the first bit clock or bit sync signal, which is repeated at the bit rate. Official Gazette of the U.S. Patent Office

N71-24614* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

VHF/UHF PARASITIC PROBE ANTENNA Patent

Herbert E. Cribb, inventor (to NASA) Issued 10 Nov. 1970 (Filed 6 Sep. 1967) 4 p Cl. 343-703; Int. Cl. H01q1/40
(NASA-Case-XKS-09340; US-Patent-3,540,056;
US-Patent-Appl-SN-666555) Avail: US Patent Office CSCL 17B

A parasitic probe antenna which couples RF energy from a spacecraft antenna to other antennas located at remote points from the spacecraft is described. The parasitic probe antenna consists of a tubular member having an aluminized tape on the interior thereof for receiving RF energy from the spacecraft antenna when the tubular member is positioned over the spacecraft antenna. The radio signals received by the aluminized tape are transmitted by transmission lines to the remote antennas. The remote antennas transmit the radio signals through free space to distant buildings housing equipment used to test the spacecraft prior to launch. Official Gazette of the U.S. Patent Office

N71-24621* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SATELLITE COMMUNICATION SYSTEM AND METHOD Patent

Robert J. Darcey, inventor (to NASA) Issued 8 Dec. 1970 (Filed 12 Dec. 1968) 10 p Cl. 179-15; Cl. 325-4; Cl. 343-100; Int. Cl. H04j1/20
(NASA-Case-GSC-10118-1; US-Patent-3,546,386;
US-Patent-Appl-SN-783375) Avail: US Patent Office CSCL 17B

A communication system and method are described that include a synchronous satellite as a relay station with large and small user transmission and reception sites. Large and small users are respectively defined as transmission and receiving sites having receiving antennas with apertures greater than 40 feet and less than 20 feet. From the large user sites a multiplicity of 3.1 KHz frequency multiplexed channels, at 4 KHz spacing, each having a suppressed subcarrier which is single sideband AM modulated on a suppressed carrier transmitted to the satellite. From small and/or large user sites in the portion of the spectrum where the omitted channels would lie, signals are FM modulated on a subcarrier displaced from the suppressed carrier and transmitted to the satellite. At the satellite the AM and FM channels are converted to a spectrum including a pair of phase modulated side bands and a carrier. Official Gazette of the U.S. Patent Office

N71-24622* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SIGNAL PROCESSING APPARATUS FOR MULTIPLEX TRANSMISSION Patent

Lawrence Y. Lim, inventor (to NASA) Issued 15 Dec. 1970 (Filed 30 Apr. 1968) 7 p Cl. 179-15; Cl. 324-77; Int. Cl. H04j3/00
Sponsored by NASA
(NASA-Case-NPO-10388; US-Patent-3,548,107;
US-Patent-Appl-SN-725432) Avail: US Patent Office CSCL 17B

An apparatus is described for sampling an input signal during a sampling period by deriving its Fourier components to allow reconstruction by a Fourier approximation. The sampling apparatus comprises many coefficient generators, each of which modulates the input signal by a sinusoidal wave and integrates the product over the sampling period to obtain a Fourier component coefficient. Official Gazette of the U.S. Patent Office

N71-24624* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

PROGRAMMABLE TELEMETRY SYSTEM Patent

Marvin S. Maxwell, Paul M. Feinberg, Eugene A. Czarcinski, Joseph R. Silverman, and John G. Lesko, Jr., inventors (to NASA) Issued 8 Dec. 1970 (Filed 20 Aug. 1968) 33 p Cl. 340-172.5; Int. Cl. G06f3/00; Int. Cl. H04q7/00
(NASA-Case-GSC-10131-1; US-Patent-3,546,684;
US-Patent-Appl-SN-754055) Avail: US Patent Office CSCL 09F

A telemetry data controller is described that includes a switch for time division multiplexing of a plurality of analog and digital inputs to a transmitter. The switch is under the control of a programmable, computer type memory, certain portions of which can be changed at will. The memory controls the switches so that different data sources can be sampled at different rates. The analog signals are fed to an analog-to-digital converter, whereby all transmission is of digital signals.
Official Gazette of the U.S. Patent Office

N71-24625* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

RADAR ANTENNA SYSTEM FOR ACQUISITION AND TRACKING Patent

Richard F. Broderick, inventor (to NASA) Issued 10 Nov. 1970 (Filed 9 Oct. 1968) 6 p Cl. 343-113; Int. Cl. G01s3/48
(NASA-Case-XMS-09610; US-Patent-3,540,054;
US-Patent-Appl-SN-766170) Avail: US Patent Office CSCL 17I

A fine tuning acquisition and tracking interferometer radar antenna system is reported. It includes a first antenna array of at least three receiving antennas. The array includes a receiving antenna, a coarse tuning antenna and a fine tuning antenna, arranged such that the linear spacing distance between the fine tuning antenna and the reference antenna is at least ten times the linear spacing distance between the coarse tuning antenna and the reference antenna. Phase detector means are provided for detecting and comparing the phases of signals received by the reference antenna, the fine tuning antenna and the coarse tuning antenna and producing an electrical output representative of phase differences, whereby the coarse tuning antenna may be used for acquisition and the fine tuning antenna may be used for tracking pruposes.
Official Gazette of the U.S. Patent Office

N71-24629# Naval Research Lab., Washington, D.C.

THE NRL MICROWAVE SPACE RESEARCH FACILITY. COMPUTER SYSTEM SOFTWARE FOR CONTROL OF THE 60 FOOT X-BAND ANTENNA Final Report

Charles A. Bass and Theodore F. Schmeckpeper 25 Jan. 1971 66 p refs
(AD-719386; NRL-7188) Avail: NTIS CSCL 17/9

To extend the Navys program in satellite communications, a fully steerable 60-ft X-band antenna system has been completed at the Naval Research Laboratorys Microwave Space Research Facility at Waldorf, Maryland. The antenna can be operated in five different modes. In one of these, the digital mode, a general-purpose digital computer has been programmed to provide direct digital control of the antenna position. Software developed at the site has been organized into two operating systems. A nonreal-time system is comprised of a resident monitor and basic utility programs necessary for efficient operation of a computer installation. The second system, which provides digital control of the antenna in a real-time environment, is of a multilevel, time-shared structure. Four software levels are executed on a priority basis by a real-time executive. Two levels may be utilized for execution of auxiliary programs concurrently with antenna control. Several interrupt processing routines provide linkage to the real-time dynamics of the antenna system. Author (GRA)

N71-24630*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

ARBITRARILY SHAPED DUAL REFLECTORS ANTENNA

C. Yeh 1 May 1971 14 p refs
(Contract NAS7-100)
(NASA-CR-118268; JPL-TR-32-1503) Avail: NTIS CSCL 09E

An analysis based on geometrical optics for a dual-reflector

antenna system with two arbitrarily shaped reflectors is carried out. Formulas for the phase and amplitude distribution in the aperture of the second reflector are obtained when the source function and the reflector surfaces are given. A design technique based on the derived formulas is also discussed. Author

N71-24713# Naval Research Lab., Washington, D.C.
THE UPWIND/DOWNWIND DEPENDENCE OF THE DOPPLER SPECTRA OF RADAR SEA ECHO Final Report
M. B. Laing 19 Jan. 1971 23 p refs
(AD-719383; NRL-7229) Avail: NTIS CSCL 17/9

The upwind/downwind dependence of the doppler spectra of radar sea echo was investigated using the coherent radar data collected with the Four-Frequency Radar (4FR) System at three frequencies: 428, 1228, and 4455 MHz. The data corresponded to sea conditions which varied from the relative calm found in Bermuda in January 1970, to 24-m/sec winds and 8-meter wave heights in the North Atlantic in February 1969. The bandwidth of the spectra was found to be relatively insensitive to wind direction, depending rather on significant wave height. But the magnitude of differential doppler (the difference in mean frequency between the horizontal and vertical spectra) is quite sensitive to the direction of the wind, having an observed upwind/downwind ratio of about two to one. Other dependencies on radar frequency and polarization are in general agreement with those found in 1970 by Valenzuela and Laing. Author (GRA)

N71-24720# Joint Publications Research Service, Washington, D.C.
RADAR AMPLIFIERS WITH INSTANTANEOUS AUTOMATIC GAIN CONTROL
A. P. Lukoshkin 15 Apr. 1971 18 p Transl. into ENGLISH from the book 'Radiolokatsionyye Usiliteli s Bolshim Diapazonom Vkhodnykh Signalov' Moscow, Sov. Radio Publishing House, 1964 p 20-30 and 224-231
(JPRS-52891) Avail: NTIS

CONTENTS:

1. PROTECTION AGAINST OVERLOADS THROUGH USE OF INSTANTANEOUS AUTOMATIC GAIN CONTROL p 1-9 (See N71-24721 13-07)

2. AMPLIFIERS WITH INSTANTANEOUS AUTOMATIC GAIN CONTROL (IAGC) p 10-17 (See N71-24722 12-07)

N71-24721# Joint Publications Research Service, Washington, D.C.
PROTECTION AGAINST OVERLOADS THROUGH USE OF INSTANTANEOUS AUTOMATIC GAIN CONTROL
In its Radar Amplifiers with Instantaneous Autom. Gain Control 15 Apr. 1971 p 1-9 (See N71-24720 13-07)
Avail: NTIS

The use of instantaneous automatic gain control (IAGC) in tracking radar is discussed in terms of operating advantages. The operation of the IAGC is shown to be based on the selection of signals and interference according to duration and amplitude. Diagrams explaining the operating principles are included. The fact that it does not shield the receiving channel from saturation by short pulse-type interference and fluctuating overshoots is considered a disadvantage. F.O.S.

N71-24722# Joint Publications Research Service, Washington, D.C.
AMPLIFIERS WITH INSTANTANEOUS AUTOMATIC GAIN CONTROL (IAGC)
In its Radar Amplifiers with Instantaneous Autom. Gain Control 15 Apr. 1971 p 10-17 (See N71-24720 13-07)
Avail: NTIS

The requirements of high gain with a low time constant by an IAGC amplifier are discussed in terms of providing stability to the system. The IFA stage with IAGC circuit, which is considered an automatic control system is analyzed, and equations establishing the relationship between the output and input are derived. F.O.S.

N71-24741* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DECODER SYSTEM Patent
Tage O. Anderson, inventor (to NASA) Issued 17 Nov. 1970 (Filed 9 Feb. 1968) 11 p Cl. 235-152; Int. Cl. G06f7/02 Sponsored by NASA
(NASA-Case-NPO-10118; US-Patent-3,541,314; US-Patent-Appl-SN-704485) Avail: US Patent Office CSCL 09D

The apparatus ascribes a confidence factor to each received binary symbol indicating the ratio between the received signal level representative of the symbol and the signal level which would be received in the absence of noise. A dictionary is provided defining a plurality of words, each comprised of a plurality of bits. Each received word is compared with all of the dictionary words to determine the correlation value therebetween. A received word is compared with a dictionary word by multiplying the confidence factor of each symbol of the received word with the corresponding bit of the dictionary word. The products so developed are then summed to yield a correlation value. The dictionary word yielding the highest correlation value when compared with the received word identifies the received word.
Official Gazette of the U.S. Patent Office

N71-24742* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TELEVISION SIGNAL PROCESSING SYSTEM Patent
Robert Y. Wong, inventor (to NASA) Issued 17 Nov. 1970 (Filed 19 Dec. 1967) 8 p Cl. 178-7.1; Int. Cl. H04n5/20 Sponsored by NASA
(NASA-Case-NPO-10140; US-Patent-3,541,250; US-Patent-Appl-SN-691737) Avail: US Patent Office CSCL 09F

A system for converting video signals from a camera to digital outputs is described. The system indicates brightness levels, has a circuit for sampling the camera ac output, and generates a pulse of a length proportional to the peak value of the sample. The pulse length operates a counter with digital output.
Official Gazette of the U.S. Patent Office

N71-24840* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TEMPERATURE TELEMETRIC TRANSMITTER Patent
Royal G. Harrison, inventor (to NASA) Issued 17 Nov. 1970 (Filed 30 Jan. 1969) 5 p Cl. 325-113; Int. Cl. H04b1/02 Sponsored by NASA
(NASA-Case-NPO-10849; US-Patent-3,541,450; US-Patent-Appl-SN-795182) Avail: US Patent Office CSCL 09F

A temperature telemetric transmitter is described comprising a resonant feedback oscillator having a frequency determining tank circuit in which a spiral-wound, printed-circuit inductor functions as an antenna for short range transmission. At least one voltage-variable capacitor is included in a branch parallel to the inductor. A thermistor, connected in series with a resistor, provides a bias that varies as the function of temperature for the voltage-variable capacitor to vary the frequency of the oscillator accordingly. For heat transfer investigation of a given material the thermistor is deposited as a very thin film on a substrate of the material and thermally insulated except from the substrate. For fast calorimetric response to small changes in environmental temperature, the substrate is also provided as a thin film.
Official Gazette of the U.S. Patent Office

N71-24913*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A 1540 TO 1660 MHz PROPAGATION BETWEEN GEOSTATIONARY SATELLITES AND AIRCRAFT Summary Report

C. E. Wernlein (Westinghouse Elec. Corp., Baltimore, Md.) Nov. 1970 50 p refs
(NASA-TM-X-65508; X-490-71-72) Avail: NTIS CSCL 17I

The propagation and system factors influencing the validity of an L band communication system between geostationary satellites and aircraft terminals, are discussed. Also discussed are the effects of ionospheric and tropospheric absorption, scintillation, range bias, Faraday rotation, earth reflected multipath, and system noise. E.H.W.

N71-24914*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ABSORPTION EFFECT ON VHF PROPAGATION BETWEEN SYNCHRONOUS SATELLITE AND AIRCRAFT Summary Report
Edward J. Mueller (Westinghouse Elec. Corp., Baltimore, Md.) Dec. 1970 50 p refs
(NASA-TM-X-65507; X-490-71-44) Avail: NTIS CSCL 17B

Ionospheric and tropospheric absorption, in terms of geographical contour, are discussed for the very high frequencies in an aeronautical satellite system. The North Atlantic region was chosen as the test area. The system comprises two geostationary satellites. Conclusions indicate no allowances need be made for tropospheric absorption, but that auroral and ionospheric absorption should be considered in North Atlantic design. Results also show that aeronautical routing, operational procedures, and telecommunications systems design must be considered. E.H.W.

N71-24951# Lockheed Missiles and Space Co., Sunnyvale, Calif.
PROPAGATION IN A MEDIUM WITH LARGE SCALE INHOMOGENEITIES (SMOOTH PERTURBATIONS METHOD)
S. M. Rytov [1971] 13 p Transl. into ENGLISH from the publ. 'Vvedenie v Statisticheskuiu Radiofiziku' Moscow, 1966 p 379–394
(AD-719853) Avail: NTIS CSCL 20/14

Propagation in a Medium with Large-scale Inhomogeneities Smooth Perturbations Method. GRA

N71-24954# Hawaii Univ., Honolulu. Information Sciences Program.
THE THEORY OF DIGITAL PROCESSING OF STOCHASTIC SIGNALS FOR USE IN AVIONIC SYSTEMS ON-BOARD AIR FORCE AIRCRAFT Final Scientific Report, 1 Jan. 1967–31 Dec. 1970
N. Thomas Gaarder Mar. 1971 17 p refs
(Grant AF-AFOSR-1251-67)
(AD-719822; CER-PRE-70101; AFOSR-TR-71-0494) Avail: NTIS CSCL 9/4

The report contains a description of the University of Hawaii research program in the theory of digital processing of stochastic signals for use in avionic systems on-board Air Force aircraft. The majority of new signal processors in avionic communication and control systems are being realized digitally. They are realized digitally because the advent of the present integrated circuit technology has led to inexpensive, reliable, flexible, and light weight systems. The discrete nature of these digital processors coupled with the stochastic nature of their input signals imposes constraints upon such systems that should be considered in the design of such systems. Author (GRA)

N71-24958# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON CONNECTION OF A PHOTO RECEIVER AND ELECTRONIC LOOP IN OPTICAL COMMUNICATIONS SYSTEMS
G. V. Voishvillo et al 1971 6 p refs Transl. into ENGLISH from Radiotekhn. (USSR), v. 25, no. 10, 1970 p 13–18
(AD-719850) Avail: NTIS CSCL 17/2

The considered analysis of the circuit connecting a receiver of optical signals in an amplifier stage and the proposed criterion of optimal connection according to the maximum of the effective signal-to-noise ratio mu are without the disadvantages of the criterion of the minimum noise coefficient or an a arbitrary signal-to-noise ratio, which are ambiguous conditions for best detection. From the analysis presented, in particular, different regularities result for the change in quality of detection as the resistance R sub mu changes. Moreover, the influence of the signal shape on the conditions for connecting a photo-receiver to an electronic circuit becomes evident, which results in the correct formulation of the problem of optimal signal shape. Author (GRA)

N71-24980# Lockheed Missiles and Space Co., Sunnyvale, Calif.
OPTICAL CHARACTERISTICS OF SCANNING SYSTEMS OF THERMAL VIEWERS
N. I. Kulikovskaia et al [1971] 5 p refs Transl. into ENGLISH from Opiko-Mekh. Prom. (Leningrad), no. 10, 1970 p 21–23
(AD-719852) Avail: NTIS CSCL 17/5

The optical characteristics of some scanning schemes utilized most frequently in thermal viewers are examined, i.e., scanning by plane mirrors and prisms arranged in both a parallel path and in a convergent beam, scanning by rotating wedges. Author (GRA)

N71-25053# Lockheed Missiles and Space Co., Sunnyvale, Calif.
SCANNING SYSTEMS FOR THERMAL VIEWERS
E. Ia. Karizhenskii et al [1971] 6 p Transl. into ENGLISH from Optiko-Mekh. Prom. (Leningrad), no. 9, 1970 p 39–42
(AD-719854) Avail: NTIS CSCL 17/5

Some questions associated with the development of scanning systems for thermal viewers are examined. Recommendations are made for the selection of such systems. Author (GRA)

N71-25058# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ELECTROMAGNETIC SIGNAL PROPAGATION ALONG WITH EARTH IONOSPHERE WAVEGUIDE
V. V. Ivanov et al 1971 7 p refs Transl. into ENGLISH from Geomagnetism i Aeronomiya (Moscow), v. 10, no. 6, 1970 p 1010–1024
(AD-719844) Avail: NTIS CSCL 20/14

Observed signal properties are interpreted as the result of signal propagation along a spherical waveguide formed by the earths surface and the ionosphere. The signal record is connected with the geographic characteristics of the radiation source. The effect of rotation of the plane of polarization of the signal being propagated along a waveguide with an optically active wall is detected. GRA

N71-25059# Lockheed Missiles and Space Co., Sunnyvale, Calif.
INFLUENCE OF SECONDARY RADIATION FLUXES ON THE OPERATION OF AN INFRARED RADIOMETER
M. M. Miroshnikov et al 1971 5 p ref Transl. into ENGLISH from Opt. Mekh. Prom. (Leningrad), v. 37, no. 10, 1970 p 3–6
(AD-719846) Avail: NTIS CSCL 17/5

The influence of fluxes due to the intrinsic and reflected radiation of elements of its optical system on the operation of an infrared radiometer when the temperature of the ambient medium changes is examined. GRA

N71-25084*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PREDICTED AND MEASURED POWER DENSITY DESCRIPTION OF A LARGE GROUND MICROWAVE SYSTEM
D. A. Bathker 15 Apr. 1971 40 p refs
(Contract NAS7-100)
(NASA-CR-118324; JPL-TM-33-433) Avail: NTIS CSCL 20N

A comparison between predicted and measured microwave field strengths on, near, and in the far field of a large ground

antenna system is given. The system consists of a high power S-band transmitter and parabolic reflector. Use of the radiation patterns of the feed system is adopted as accounting for the total power output. Estimates of secondary or stray radiation are given and discussed. A first order tubular beam concept is introduced to simplify and provide a clear impression. It is concluded certain safety restrictions are necessary, and these are discussed. Author

N71-25085*# Illinois Univ., Urbana. Ionosphere Radio Lab.
RADIO WAVE SCATTERING FROM RANDOM FLUCTUATIONS IN AN ANISOTROPIC MEDIUM
Dale M. Simonich and Kung C. Yeh Mar. 1971 150 p refs
(Grants NGR-14-005-002; NSF GS-13723)
(NASA-CR-118332; UILU-ENG-71-2541) Avail: NTIS CSCL 17B

Scattering of electromagnetic waves from random electron density fluctuations in a cold magnetoplasma is studied. A Green's function is developed as a superposition of characteristic waves and is asymptotic for large distances. It is then used to solve to two kinds of problems using the Born approximation. In the bistatic scattering problem, a transmitter beams power at a region in space which contains random fluctuations in electron density. In the radio star problem, a radio wave propagates through an infinite slab and is received below the slab. Two general conclusions are made: (1) The solution can depend very strongly on the relationship among the incident ray vector, the scattered ray vector, and the dc magnetic field vector. The degree of variation increases as the medium becomes more anisotropic. (2) Mode conversion is caused by those fluctuations whose correlation length is of the order of the wavelength. If the correlation length is much larger than the wavelength mode conversion is negligible. Author

N71-25100# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VARIABILITY OF ATMOSPHERIC REFRACTION COEFFICIENT FOR ULTRASHORT RADIO WAVES IN THE LOWER 1.5-km LAYER OF THE TROPOSPHERE OVER GAZLI STATION IN SEPTEMBER 1964
V. A. Volodina 23 Nov. 1970 12 p refs Transl. into ENGLISH from Tashkent Univ. Nauchn. Tr. (USSR), no. 322, 1968 p 85–89
(AD-719830; FTD-HT-23-719-70) Avail: NTIS CSCL 4/1

The results of helicopter sounding of the atmosphere at 0400, 0700, 1000, 1200 and 1530 hours Moscow time were used for determining the variability of the coefficient of refraction. At 0400 hours the refractive index of dry and moist air decreases with altitude. At 0700 hours dry decreases below the 500-m level and moist increases insignificantly above that level. At 1000, 1200 and 1530 hours moist has its maximum value at the earths surface and decreases slowly with height. The mean values of temperature, pressure and humidity were used in computing N. The results of computations show that the differences in the mean values N, computed by different methods, do not exceed 1.3 unit. Author (GRA)

N71-25101# Army Electronics Command, Fort Monmouth, N.J.
TRANSMISSION OF DIGITAL SIGNALS OVER CABLE
William M. Goodall Nov. 1970 72 p ref
(AD-719688; ECOM-3361) Avail: NTIS CSCL 17/2

The results of a theoretical and experimental investigation for the design of an optimum digital transmission system are presented in the report. The objective of the investigation was to provide a basis for design of future military multichannel digital transmission systems. A fundamental study of a digital cable transmission system shows that a complete system can be made using two subsystem building blocks. These subsystems are a high level multilink linear analog channel and a time-amplitude decision regenerator. An optimum band limited design uses Nyquist Digital Transmission. The overall design is based upon minimizing errors due to signal dependent and signal independent error producing disturbances. The results of experiments transmitting 5 MHz digital signals over 5 miles of Cable CX-11230 using the multilink linear analog approach are given. Author (GRA)

N71-25116# Lockheed Missiles and Space Co., Sunnyvale, Calif.
KIK: SOLICITOUS HANDS OF THE EARTH
P. Agadzhanov et al [1971] 6 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 11, 1970 p 36–38
(AD-719848) Avail: NTIS CSCL 22/2

The report describes methods used by the Soviet Union to maintain communication and guidance control systems between manned spacecraft and earth-based control stations. GRA

N71-25166# Aerospace Corp., El Segundo, Calif. Electronics Div.
AM CROSSTALK IN UNIFIED CARRIER TELEMETRY SYSTEMS
C. O. Velline 15 Oct. 1970 32 p refs
(Contract F04701-70-C-0059)
(AD-719733; TR-0059(6472)-1; SAMSO-TR-71-40) Avail: NTIS CSCL 9/6

Under the unified carrier concept several angle-modulated subcarriers are combined and phase modulated on an RF carrier. As a practical matter in a hardware system the angle-modulated subcarriers will contain a certain amount of amplitude ripple. Conceptually, a subcarrier with AM ripple can be viewed as a constant envelope subcarrier with a continuously varying modulation index. It follows that a continuous transfer of AM between the components in the unified carrier spectrum will occur due to the varying envelope (modulation index) of any data subcarrier. The report discusses in some detail the problem of crosstalk transferred to the PM carrier from a single subcarrier which is biphase modulated with PCM data. The implications to carrier false lock and tracking are studied. Analytic and experimental results are presented. Author (GRA)

N71-25169# Aerospace Corp., El Segundo, Calif. Lab. Operations.
A COMPARISON OF MECHANICAL CONICAL SCAN AND PSEUDO MONOPULSE ANGLE TRACKING SYSTEMS
Edmond S. Klotz 22 Oct. 1970 40 p refs
(Contract F04701-70-C-0059)
(AD-719735; TR-0059(6472)-4; SAMSO-TR-71-41) Avail: NTIS CSCL 17/9

The equivalence of synthetic conical scan (pseudo-monopulse) to mechanical conical scan is shown. A comparison of system noise temperatures in the angle tracking systems is made among mechanical conical-scan systems, single-preamplifier synthetic conical-scan systems, and three-preamplifier synthetic conical-scan systems. It is shown that synthetic conical-scan systems compare favorably with mechanical conical-scan systems when high values of slope are available from the monopulse comparator and when used in applications where modest tracking accuracy (in the order of 0.1 beamwidth) is acceptable. Author (GRA)

N71-25185# Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
ANALYSIS OF VHF AND X-BAND TELEMETRY SYSTEMS DEGRADATION BY REENTRY ENVIRONMENT Research Report, May 1969 - Jun. 1970
Kurt E. Golden, Donald A. McPherson, and Kenneth P. Horn 1 Feb. 1971 38 p refs
(Contract F04701-70-C-0059)
(AD-719738; TR-0059(9220-02)-7; SAMSO-TR-71-42) Avail: NTIS CSCL 9/6

The degradation of VHF and X-band telemetry by the reentry plasma sheath has been analyzed for recent flight tests of a hypersonic reentry vehicle. A self-consistent technique utilizing the

received signal strengths of both the VHF and X-band transmitters was used. It was determined that the attenuation was caused by electrons flowing back over the antennas from the stagnation region at the nose. For the X-band signal, the attenuation was a result of pattern distortion caused by refraction in the plasma layer and distortion of the field distribution in the antenna aperture. At VHF, the plasma layer is electrically thin, and the signal loss resulted from the combined effects of reflection and absorption.
Author (GRA)

N71-25317*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRELIMINARY ANTENNA RADIATION PATTERN CALCULATIONS FOR THE ATS F FLEX RIB REFLECTOR
Richard F. Schmidt *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 259-262 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 17B

Computerized radiation pattern calculations, using vector analysis and differential geometry to determine vector sheet currents on reflector surface, are compared to full scale measurements on a 30-ft ATS F reflector that consists of 48 supporting ribs and stretched metallized Dacron mesh in a close approximation of a paraboloid. Agreement between the calculated values and actual measurements was good for a flexible rib design. Effects of thermal distortions of reflector surfaces on gain and beamwidth parameters were also determined by computations. G.G.

N71-25320*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPERIMENTAL ANALYSIS OF MERCURY CADMIUM TELLURIDE PHOTOVOLTAIC IR MIXERS FOR SPACECRAFT RECEIVERS
John H. McElroy *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 272-274 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 17B

A p-n junction mercury cadmium telluride semiconducter, used as a reverse-biased photodiode, was evaluated as infrared mixer for 100 K operation in a CO2 laser communication system. Experimental results established near quantum-limit performance and a sufficient frequency response of the 100 K infrared mixer to meet ATS F laser communication receiver requirements. G.G.

N71-25339*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APOLLO SLOW SCAN TV SIGNAL ENHANCEMENT
Edward J. Prokop *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 344-349 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 17B

A mathematical model that operates in a feedback manner and whose form is analogous to the Lorentz transformation of relativity is formulated and implemented to provide television image enhancement for real time TV signals from Apollo spacecraft. TV signal enhancement is achieved by gain control that raises amplifier output in the dark areas of the scene and lowers it in the light areas. Gain control is formed by feeding the enhanced video to a scan converter that acts as a one-scan field memory so that the enhanced TV image formed in one scan field can be used in the next scan field. Two dimensional low pass filtering of the image presents details clearly throughout the picture. It is shown that the described feedback image enhancement method produces a video signal that tolerates much lower signal-to-noise ratios in a transmission channel without markedly degrading the resultant images. G.G.

N71-25343# Queens Univ., Kingston (Ontario). Dept. of Electrical Engineering.
OPTIMUM RECEPTION OF DIGITAL FM SIGNALS
J. Le Roy Pearce Mar. 1971 110 p refs Sponsored in part by Natl. Res. Council of Can.
(RR-71-1) Avail: NTIS

The problem of synthesizing FM receiver structures is examined and two receiver structures called the Optimum Decision Feedback Receiver, and the Linear Equalized FM Receiver, are developed. Error performance curves have been calculated and are presented. Finally, a comparison is made between the performance of these new FM systems and conventional equalized pulse amplitude modulation (PAM) systems. It is concluded that equalized continuous phase digital FM can be expected to yield an error performance at least comparable to the performance of equalized PAM systems.
Author

N71-25344# Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev.
FREQUENCY INTERFERENCE PREDICTION: CDC-6400 COMPUTER PROGRAM
Feb. 1971 66 p Sponsored by AEC
(EGG-1183-1509; L-1023) Avail: NTIS

Frequency intermodulation products are calculated for the purpose of predicting frequency interference between given sets of transmitters and receivers. Transmitter and receiver data are input and interference data are output. Author (NSA)

N71-25345# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
A NEW EXAMPLE OF STABLE SOLITARY WAVES
Nobuo Yajima and Akiji Outi Mar. 1971 12 p refs
(RIFP-117) Avail: NTIS

A numerical calculation validates that the solitary waves of a nonlinear Schrodinger equation are remarkably stable and never lose their identities through nonlinear interaction between them, similar to the solutions of the Korteweg-de Vries equation. The formation of solitary waves from an initial disturbance is also studied. Author

N71-25346# Sandia Corp., Albuquerque, N.Mex.
EXCITATION OF INTERNAL CIRCUITRY BY THE PROPAGATION OF AN ELECTROMAGNETIC FIELD THROUGH A TRANSVERSE SLOT IN A MISSILE SKIN
Charles W. Harrison, Jr. and Ronold W. P. King (Harvard Univ., Cambridge, Mass.) Oct. 1970 18 p refs Sponsored by AEC
(SC-R-70-4339) Avail: NTIS

A rocket with removed access plate is simulated by a section of coaxial transmission line with a transverse rectangular slot cut in its sheath. The internal circuit consists of two arbitrary impednances in series with the inner conductor at its ends. The object is to find the currents in these impendances when the cylinder is illuminated from the outside by an electromagnetic field that enters the aperature and excites the internal circuit. The problem is solved by application of the reciprocal theorem. The current in a dipole antenna is determined when it is in the far field maintained by the slotted coaxial line when driven by a generator in series with one of the load impednances. The reciprocal theorem gives the current in this impedance when the distant dipole is driven. A numerical example is given. Author (NSA)

N71-25347# Australian Post Office Research Labs., Melbourne.
THE 2 GHz PROPAGATION MEASUREMENTS ON LONG OVERWATER PATHS: MOUNT TANNER (FLINDERS ISLAND) TO WATERHOUSE (TASMANIA), 68 MILES, MARCH 1964-FEBRUARY 1966
R. A. Harvey Oct. 1970 18 p refs
(Rept-6118) Avail: NTIS

Measurements on this path, the shorter of the two long overwater hops of the Melbourne-Launceston microwave system, showed that fading was more frequent, prolonged and severe in

summer than in winter months, with no diurnal effects apparent. The mean signal level was seldom depressed, the median level never falling more than 30 dB below the free space value. Vertically spaced antennas, separated by a 50 ft interval showed adequate switched diversity improvement, exceeding 10dB for 99.94% of the time. Height-gain measurements showed the simple interference pattern expected between the direct and sea reflected rays. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For applications, see specific categories. For related information see also: 19 Mathematics

N71-24421# Technical Univ. of Denmark, Lyngby. Lab. of Electromagnetic Theory.

EXECUTION TIMES ON IBM 7094 AND IBM 360/75 AT NEUCC

Erik Drago Nielsen Feb. 1971 10 p

(R-87) Avail: NTIS

Information is given to the user about the average execution times for standard operations carried out in connection with run of FORTRAN 4 programs on the IBM 7094 and IBM 360/75 computers at NEUCC, Technical University of Denmark. Author (ESRO)

N71-24580# National Bureau of Standards, Washington, D.C. Office of Information Processing Standards.

ON COMPUTER PERFORMANCE MEASUREMENT PROGRAMMING: MEASURING INDEXING ADROITNESS BY ISOLATING COMPLEX PRIMES

George W. Reitwiesner Apr. 1971 25 p refs

(NBS-TN-572) Avail: SOD $0.35 CSCL 09B

The computer performance test program reported making measurements regarding specific properties of computer operation. The program is written in a particular problem oriented programming language; therefore assessment perforce spans the effects of the computer hardware, of the programming language, and of the intervening compiler processes. The objective of the test is to assess adroitness in certain indexing operations. Assessment is accomplished by measuring execution time of a recursive programming loop. The test program performs a simple computation for which the solution is completely definitive, yet for which both the solution and the time for achieving it are variable under parameters whose values are introduced as program input data. Author

N71-24594*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPUTER PROGRAM FOR THERMAL ANALYSIS OF TANK MOUNTED MULTILAYER INSULATION

Glenn R. Cowgill and William P. Johnson Washington May 1971 62 p refs

(NASA-TN-D-6228; E-5911) Avail: NTIS CSCL 09B

An analysis was done on the space-hold thermal performance of various multilayer insulation configurations on an oblate spheroidal tank. The thermal code CINDA-3G (Chrysler Improved Numerical Differencing Analyzer for Third Generation Computers) was used for the thermal analysis, and several subroutines were written to tailor it for the needs of the problem. A portion of the tailoring is called the pre-preprocessor, which generates the data required as input to CINDA-3G. This pre-preprocessor and allied subroutines comprise a package to obtain a parametric thermal study with a minimum amount of input data. Parameters may be changed with a minimum of effort. Author

N71-24633* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SELF-TESTING AND REPAIRING COMPUTER Patent

Algirdas A. Avizienis, inventor (to NASA) Issued 23 Jun. 1970 (Filed 30 Oct. 1967) 18 p Cl. 235-153; Int. Cl. G06f11/04 Sponsored by NASA

(NASA-Case-NPO-10567; US-Patent-3,517,171; US-Patent-Appl-SN-679055) Avail: US Patent Office CSCL 09B

A computer system composed of a number of functional units, each performing a major function is described. The system includes a Control and Diagnostic Unit (CDU) which continually monitors the units for faults and replaces a faulty unit by switching off its power and switching on power to its replacements. The functional units communicate with each other over only two busses, and all communicated words are encoded by error detecting codes. As a result, two bus checking units which monitor the two busses detect errors indicated by the codes and send fault indicating signals to the CDU. When a fault is detected, the CDU stops the program and resumes it at a previous rollback point indicated on the computer program. The program contains numerous rollback points along it, at which the computations can readily be resumed. If the fault persists, the faulty unit is replaced. Official Gazette of the U.S. Patent Office

N71-24650* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SERIAL DIGITAL DECODER Patent

Richard R. Green, inventor (to NASA) Issued 27 Oct. 1970 (Filed 15 Aug. 1967) 9 p Cl. 340-347; Int. Cl. G06f5/00 Sponsored by NASA

(NASA-Case-NPO-10150; Us-Patent-3,537,103; US-Patent-Appl-SN-660843) Avail: US Patent Office CSCL 09B

A decoder is described for decoding a message encoded with a code word from a square (2 to the nth $\times$ 2 to the nth) symmetrical matrix with entries of $+1$ and -1. The decoder consists of a sequence of n substantially identical stages with each stage including a serial memory of a different storage capacity which can be expressed as $m-2$ to the pth power, where P is an integer including zero, the maximum value of P being equal to $n-1$. Official Gazette of the U.S. Patent Office

N71-24716*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

MAPS - A COMPUTERIZED MANAGEMENT ANALYSIS AND PLANNING SYSTEM

Donald R. Packe and Gil A. Raffaeli Washington May 1971 60 p

(NASA-TN-D-6169; E-5979) Avail: NTIS CSCL 09B

MAPS provides managers of large technical projects with a fast and economical information system for planning and controlling their projects. The program in the simplest terms is a computerized bar-chart schedule-reporting system in which project elements at all levels can be listed. MAPS has been specifically designed for planning and scheduling engineering project work; however, its flexible format capability permits a variety of other uses such as parts lists, configuration control, drawing lists, manpower and budget planning, and organization charts. Author

N71-24780 Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.

INFORMATION STORAGE AND RETRIEVAL: REPORTS ON ANALYSIS, DICTIONARY CONSTRUCTION, USER FEEDBACK, CLUSTERING, AND ON-LINE RETRIEVAL: PROJECT SMART, 1969 - 1970

Oct. 1970 523 p refs Prepared for NSF and the Natl. Library of Med.

(ISR-18) Copyright. Avail: Issuing Activity

CONTENTS:

1. CONTENT ANALYSIS IN INFORMATION RETRIEVAL S. F. Weiss 46 p refs (See N71-24781 13-08)

2. THE "GENERALITY" EFFECT AND THE RETRIEVAL EVALUATION FOR LARGE COLLECTIONS G. Salton 33 p refs (See N71-24782 13-08)

3. AUTOMATIC INDEXING USING BIBLIOGRAPHIC CITATIONS G. Salton 20 p refs (See N71-24783 13-08)

4. AUTOMATIC RESOLUTION OF AMBIGUITIES FROM NATURAL LANGUAGE TEXT S. F. Weiss 51 p refs (See N71-24784 13-08)

5. THE EFFECT OF COMMON WORDS AND SYNONYMS ON RETRIEVAL PERFORMANCE D. Bergmark 44 p refs (See N71-24785 13-08)

6. NEGATIVE DICTIONARIES K. Bonwit and J. Aste-Tonsmann 33 p refs (See N71-24786 13-08)

7. EXPERIMENTS IN AUTOMATIC THESAURUS CONSTRUCTION FOR INFORMATION RETRIEVAL G. Salton 28 p refs (See N71-24787 13-08)

8. VARIATIONS ON THE QUERY SPLITTING TECHNIQUE WITH RELEVANCE FEEDBACK T. P. Baker 25 p refs (See N71-24788 13-08)

9. EFFECTIVENESS OF FEEDBACK STRATEGIES ON COLLECTIONS OF DIFFERING GENERALITY B. Capps and M. Yin 33 p refs (See N71-24789 13-08)

10. SELECTIVE NEGATIVE FEEDBACK METHODS M. Kerchner 20 p refs (See N71-24790 13-08)

11. THE USE OF PAST RELEVANCE DECISIONS IN RELEVANCE FEEDBACK L. Pasvola 14 p refs (See N71-24791 13-08)

12. A CONTROLLED SINGLE PASS CLASSIFICATION ALGORITHM WITH APPLICATION TO MULTILEVEL CLUSTERING D. B. Johnson and J. M. Lafuente 37 p refs (See N71-24792 13-08)

13. A SYSTEMATIC STUDY OF QUERY-CLUSTERING TECHNIQUES: A PROGRESS REPORT S. Worona 39 p refs (See N71-24793 13-08)

14. A PROTOTYPE ON-LINE DOCUMENT RETRIEVAL SYSTEM D. Williamson and R. Williamson 40 p (See N71-24794 13-08)

15. TEMPLATE ANALYSIS IN A CONVERSATIONAL SYSTEM S. F. Weiss 41 p refs (See N71-24795 13-08)

N71-24781 Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.

CONTENT ANALYSIS IN INFORMATION RETRIEVAL

S. F. Weiss *In its* Inform. Storage and Retrieval Oct. 1970 46 p refs (See N71-24780 13-08)

Copyright. Avail: Issuing Activity

Results obtained with a variety of linguistic phrase recognition methods show that very little, if any, improvements in retrieval effectiveness are obtained when any of the refined content analysis schemes are used with existing document collections. The main reason appears to be the fact that the value of refined content analysis systems resides in their effectiveness in separating lexically similar, but semantically different documents. Existing collections are too sparse, and do not contain many close documents. When denser collections are created, it can be shown that linguistic content analysis methods become of increasing value as the density increases. The queries also influence the type of content analysis to be used. In general, queries of the question-answering variety show improved retrieval results with increasing refinements in the content analysis. Document retrieval queries do not exhibit this type of improvement. Author

N71-24782 Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.

THE 'GENERALITY' EFFECT AND THE RETRIEVAL EVALUATION FOR LARGE COLLECTIONS

G. Salton *In its* Inform. Storage and Retrieval Oct. 1970 33 p refs (See N71-24780 13-08)

Copyright. Avail: Issuing Activity

The role of the generality effect in retrieval system evaluation was assessed, and evaluation results are given for the comparison of several document collections of distinct size and generality in the areas of documentation and aerodynamics. Author

N71-24783 Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.

AUTOMATIC INDEXING USING BIBLIOGRAPHIC CITATIONS

G. Salton *In its* Inform. Storage and Retrieval Oct. 1970 20 p refs (See N71-24780 13-08)

Copyright. Avail: Issuing Activity

Bibliographic citations were used directly to identify document content, and an attempt was made to evaluate their effectiveness in a retrieval environment. It is shown that the use of bibliographic citations in addition to the normal keyword-type indicators produces improved retrieval performance, and that in some circumstances, citations are more effective for retrieval purposes than other more conventional terms and concepts. Author

N71-24784 Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.

AUTOMATIC RESOLUTION OF AMBIGUITIES FROM NATURAL LANGUAGE TEXT

S. F. Weiss *In its* Inform. Storage and Retrieval Oct. 1970 51 p refs (See N71-24780 13-08)

Copyright. Avail: Issuing Activity

Automatic disambiguation by template analysis was investigated. The evolutionary process by which ambiguities are created is discussed. This leads to classification of ambiguities into three classes: true, contextual, and syntactic. The class assigned to a given word is dependent on the syntactic and semantic functions performed by the word. Only true ambiguities are suitable for automatic resolution. Automatic disambiguation was accomplished by an extended version of template analysis. The process consisted of locating an ambiguous word and in testing its environment against a predetermined set of rules for occurrences of words and structures which indicate the intended interpretation. Experiments using this process show that a high degree of accuracy in resolution can be achieved. Author

N71-24785 Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.

THE EFFECT OF COMMON WORDS AND SYNONYMS ON RETRIEVAL PERFORMANCE

D. Bergmark *In its* Inform. Storage and Retrieval Oct. 1970 44 p refs (See N71-24780 13-08)

Copyright. Avail: Issuing Activity

The effect of removing common words from document and query vectors was investigated, using the Cran-200 collection. The method used was comparison of a standard stem dictionary and a thesaurus with a new dictionary formed by adding an extensive common word list to the standard stem dictionary. It was found that removal of common words from the query and document vectors significantly increased precision. Query and document vectors without either common words or synonyms yielded the highest precision results but inferior recall resulted. Synonyms were found to be more effective for recall than common words. Author

N71-24786 Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.

NEGATIVE DICTIONARIES

K. Bonwit and J. Aste-Tonsmann *In its* Inform. Storage and Retrieval Oct. 1970 33 p refs (See N71-24780 13-08)

Copyright. Avail: Issuing Activity

A rationale for constructing negative dictionaries is discussed. Experimental dictionaries are produced and retrieval results examined. Author

N71-24787 Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.
EXPERIMENTS IN AUTOMATIC THESAURUS CONSTRUCTION FOR INFORMATION RETRIEVAL
G. Salton *In its* Inform. Storage and Retrieval Oct. 1970 28 p refs (See N71-24780 13-08)
Copyright. Avail: Issuing Activity

Several new methods for automatic, or semiautomatic, dictionary construction are described, including procedures for the automatic identification of common words, and novel automatic word grouping methods. The resulting dictionaries are evaluated in an information retrieval environment. It appears that in addition to the obvious economic advantages, several of the automatic analysis tools offer improvements in retrieval effectiveness over the standard, manual methods in general use. Author

N71-24788 Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.
VARIATIONS ON THE QUERY SPLITTING TECHNIQUE WITH RELEVANCE FEEDBACK
T. P. Baker *In its* Inform. Storage and Retrieval Oct. 1970 25 p refs (See N71-24780 13-08)
Copyright. Avail: Issuing Activity

Some experiments in relevance feedback were performed with variations on the technique of query splitting. The results obtained indicate that these variations, as tested, offer no significant improvement over previously tried methods of query splitting. Author

N71-24789 Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.
EFFECTIVENESS OF FEEDBACK STRATEGIES ON COLLECTIONS OF DIFFERING GENERALITY
B. Capps and M. Yin *In its* Inform. Storage and Retrieval Oct. 1970 33 p refs (See N71-24780 13-08)
Copyright. Avail: Issuing Activity

The comparative effectivness of several feedback strategies on collections which differ in generality, namely the Cranfield 200 and Cranfield 400 collections is evaluated. A new query set which produces a constant number of relevant documents over the two collections was used to regulate the generality. The results were assessed from both the user and the system viewpoint with, some strategies appearing to be equally effective on both collections. Author

N71-24790 Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.
SELECTIVE NEGATIVE FEEDBACK METHODS
M. Kerchner *In its* Inform. Storage and Retrieval Oct. 1970 20 p refs (See N71-24780 13-08)
Copyright. Avail: Issuing Activity

Experiments performed with several new methods of using nonrelevant retrieved documents to modify queries which retrieve no relevant documents in the first N documents retrieved are described. The results of the experiments are evaluated and suggestions made for possible further investigations. Author

N71-24791 Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.
THE USE OF PAST RELEVANCE DECISIONS IN RELEVANCE FEEDBACK
L. Paavola *In its* Inform. Storage and Retrieval Oct. 1970 14 p refs (See N71-24780 13-08)
Copyright. Avail: Issuing Activity

A high degree of similarity may be expected to exist among documents judged to be relevant to the same query. Some possibilities were investigated for exploiting this potential similarity in relevance feedback. Runs were made on the ADI and Cranfield 424 collections of the SMART retrieval system. In these runs all jointly relevant documents were incorporated into feedback as if they were a single relevant document. Standard recall-precision evaluation measures were used, and the performance of some individual queries is illustrated. Some directions for further research are suggested. Author

N71-24792 Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.
A CONTROLLED SINGLE PASS CLASSIFICATION ALGORITHM WITH APPLICATION TO MULTILEVEL CLUSTERING
D. B. Johnson and J. M. Lafuente *In its* Inform. Storage and Retrieval Oct. 1970 37 p refs (See N71-24780 13-08)
Copyright. Avail: Issuing Activity

A single pass clustering method is presented, which compares favorably with more expensive clustering algorithms. During the clustering process various parameters are controlled, such as number of clusters, size of the clusters and amount of overlap. The method was tested using the ADI collection of 82 documents and the Cranfield 424 collection. The results are compared to full search and to results obtained by searching clusters produced by Dattola's algorithm. The effect of ordering of the collection was investigated and some variation was obtained in the results for different orderings. Single level as well as two level clustering was considered. The results, in general, point to better performance with multilevel clustering and some suggestions for extending the algorithm to include multilevel clustering are given. Author

N71-24793 Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.
A SYSTEMATIC STUDY OF QUERY-CLUSTERING TECHNIQUES: A PROGRESS REPORT
S. Worona *In its* Inform. Storage and Retrieval Oct. 1970 39 p refs (See N71-24780 13-08)
Copyright. Avail: Issuing Activity

An experiment using various techniques of query clustering on the Cranfield 424 document collection is described and some preliminary results are given. Several methods of evaluating the performance of clustered searches in the context of query clustering are discussed. Finally, some observations are made concerning use of the SMART system as implemented at Cornell University. Author

N71-24794 Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.
A PROTOTYPE ON-LINE DOCUMENT RETRIEVAL SYSTEM
D. Williamson and R. Williamson *In its* Inform. Storage and Retrieval Oct. 1970 40 p (See N71-24780 13-08)
Copyright. Avail: Issuing Activity

A design is outlined for a SMART on-line document retrieval system, using console initiated search and retrieval procedures. The conversational system is described as well as the program organization. Author

N71-24795 Cornell Univ., Ithaca, N.Y. Dept. of Computer Science.
TEMPLATE ANALYSIS IN A CONVERSATIONAL SYSTEM
S. F. Weiss *In its* Inform. Storage and Retrieval Oct. 1970 41 p refs (See N71-24780 13-08)
Copyright. Avail: Issuing Activity

A discussion of natural language conversational systems is presented. The use of natural language rather than fixed format input in such a system makes possible the implementation of a natural dialogue system, and renders the system available to a wide range of users. A set of goals for such a system is presented. These include the provision of fast responses, usable by all levels of users, and the use of intellectual aids such as tutorials. An experimental conversational system which meets these goals was

implemented using a template analysis process. Template analysis was used not only to analyze natural language input, but also to control the overall operation of the process. Experiments with a number of users show that the system is easy to utilize and provides accurate analyses. A detailed discussion of both user and system performance is presented. Author

N71-24884* + Texas A&M Univ., College Station. Inst. of Statistics.
INCOMPLETE DATA ANALYSIS
H. O. Hartley and R. R. Hocking Mar. 1971 50 p refs
(Grant NGR-44-001-095)
(NASA-CR-174967; TR-6) Avail: NTIS CSCL 05B

A simple statistical taxonomy is presented for the occurrence of incomplete data and a framework is proposed for coordinating the multitude of species of incompleteness. Unified methods of incomplete data analysis are developed and illustrated numerically. Emphasis is placed on parameter estimation from observed data of the form L = L(Y,X,Theta) where Y is a matrix of statistical variables, X is a matrix of known constants, and Theta is a vector of unknown parameters. Several classes of estimation are discussed including parameter estimation in multivariate normal distributions; linear regression analysis with missing fixed x-values; analysis of variance with missing classifications; and parameter estimation of any distribution, either continuous or discrete, from grouped data. Author

N71-24890* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
BCD TO DECIMAL DECODER Patent
Frank Byrne, inventor (to NASA) Issued 20 Oct. 1970 (Filed 21 Jun. 1967) 6 p Cl. 235 - 155; Int. Cl. H03k13/24, 13/243
(NASA-Case-XKS-06167; US-Patent-3,535,497; US-Patent-Appl-SN-649076) Avail: US Patent Office CSCL 09B

A decoder which is composed of a plurality of gates for decoding binary signals is described. The decoder utilizes feed-back or inhibit signals for preventing erroneous decoding or displaying of the decimal constituents.
Official Gazette of the U.S. Patent Office

N71-24891* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
NONINTERRUPTABLE DIGITAL COUNTING SYSTEM Patent
Robin A. Winkelstein, inventor (to NASA) Issued 17 Nov. 1970 (Filed 30 Dec. 1966) 12 p Cl. 235-92; Int. Cl. H03k21/08
Sponsored by NASA
(NASA-Case-XNP-09759; US-Patent-3,541,312; US-Patent-Appl-SN-60642) Avail: US Patent Office CSCL 09B

A noninterruptable digital counting system is described including a master multistage binary counter whose maximum propagation time is longer than the period between successive input pulses continuously supplied to the counter. A slave binary counter of equal stage length is selectively coupled to the master counter and the source of input pulses, so that both counters have the same nominal count and both respond to the same input pulses. Logic control circuitry is outlined for decoupling the slave from the master counter, preferably when the stages of both are in a quiescent state. The logic control circuitry also includes controls to disrupt the supply of input pulses at a selected time instant, so that the count therein at such instant represents the count also present in the master counter.
Official Gazette of the U.S. Patent Office

N71-24915*# Maryland Univ., College Park. Computer Science Center.
A VIRTUAL MEMORY SYSTEM DESIGN
Oliver Ray Pardo Jan. 1971 114 p refs
(Grant NGR-21-002-206)
(NASA-CR-118310; TR-144) Avail: NTIS CSCL 09B

Several current systems employing virtual memory are briefly described, and the working set strategy, the task scheduling/memory management algorithm, and the concept of a paging drum are introduced. A detailed description of the hardware and software components of a virtual memory management system is given. The hardware components which are described in CDL include the main memory, the translation memory, the page table memory, and the paging drum channel. The software components are described in ALGOL and interfaced with the hardware by defining registers as global variables and referring to hardware sequences through procedure calls. The software description includes complete description of the addressing mechanism, memory management, and tasks scheduling. Memory management is enhanced by the use of a page table memory that posts the current status of each physical page. Author

N71-25192# Illinois Univ., Urbana. Dept. of Computer Science.
[COMPUTERS] Quarterly Technical Progress Report, Jul. - Sep. 1970
1970 290 p refs
(Contracts AT(11-1)-1018; AT(11-1)-1469)
(COO-1018-1207; COO-1469-172) Avail: NTIS

Progress is reviewed for the following departmental programs: circuit research, hardware systems research, computer systems, the Illinois pattern recognition computer (Illiac 3), and the Illiac 4 system. Also discussed is work on numerical methods, computer arithmetic, artificial languages, digital computer arithmetic theory, switching theory and logical design, and the IBM system/360 service. E.C.

N71-25325*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DEVELOPMENT OF A SMALL COMPUTER FOR ON BOARD PROCESSING
Rodger A. Cliff *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 289 - 291 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 09B

A stored-program computer is described for onboard data processing that is a serial machine which uses two's-complement arithmetic. Communication with the experiments, the spacecraft command system, and the spacecraft data system is by serial input/output channels. Modifications to the SPD-3 by converting parts from parallel to serial operation and novel instructions reduced power dissipation by 30% to 1.3 W and the component count by 30% to 500 integrated circuits. G.G.

N71-25336*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AUTOMATED TRACKING DATA ANALYSIS
Paul E. Schmid *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 331 - 336 refs (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 09B

A completely automated tracking data flow is described that permits: (1) clear separation of spacecraft tracking system effects from orbit computation mathematical modeling uncertainties; (2) dynamic tracking system checkout during actual spacecraft track; and (3) tracking system measurements of range, range rate, and angles between Earth based stations and orbiting spacecraft. After tracking data are reduced to a common denominator, they are either converted to a plotting routine that permits direct viewing of metric measurement versus time, or they are subjected to polynomial curve fitting with autocorrelation and then plotted on film. G.G.

N71-25342# McGill Univ., Montreal (Quebec). Dept. of Mechanical Engineering.
ENGINEERING DRAWINGS BY DIGITAL PLOTTER
J. H. T. Wu, Y. M. Tong, and M. Donath Dec. 1970 33 p refs
(Rept-70-8) Avail: NTIS

A combined computer and plotter program for IBM-360-75 and CALCOMP-770 is presented for plotting engineering drawings. An angle bracket is used as an example to demonstrate the application of the program for obtaining: (1) orthogonal; (2) isometric; (3) dimentric; (4) trimetric; (5) oblique; and (6) prespective views. The mathematical manipulations of matrices in the homogeneous coordinates system are described for the system to be rotated and translated into a new system. To ease the understanding of the repeated manipulation of matrices, the concepts of the picture window and the right hand rule for rotation are introduced. Author

N71-25371# Aerospace Corp., El Segundo, Calif. Office for Systems Requirements.
ANIMATED RECONSTRUCTION OF TELEMETRY (ART)
Raymond G. DeBiase, Boyd E. Winn, Martin T. Rademacher, and Robert P. Gross 5 Feb. 1971 41 p
(Contract F04701-70-C-0059)
(AD-719741; TOR-0059(6452)-3) Avail: NTIS CSCL 9/2

The techniques used in the Animated Reconstruction of Telemetry (ART) permit the non-technical individual to evaluate the performance of complex technological processes. ART uses the Modularized Vehicle Simulation(MVS) Program to model the physical phenomena under study, thus ensuring conformance to the laws of physics. Animated sequences are then produced from these models to visually portray the system in reference systems chosen by the user. Author (GRA)

N71-25388*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPUTER ACQUIRED PERFORMANCE DATA FROM AN ETCHED-RHENIUM, NIOBIUM THERMIONIC CONVERTER
Richard B. Lancashire Washington May 1971 89 p refs
(NASA-TM-X-2262; E-6017) Avail: NTIS CSCL 09B

Performance data from an etched rhenium, niobium thermionic converter are presented. The converter had a guard ringed collector and a fixed space of 10 mils. The data were obtained using a computer for data acquisition, and are presented on J,V P,V curves. The diode was tested at emitter temperatures from 1550 K to 2010 K, collector temperatures from 850 K to 1180 K, and cesium reservoir temperatures from 525 K to 650 K. Author

N71-25392*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
FEASIBILITY STUDY: ON-LINE DIGITAL COMPUTER FOR ANALYTICAL OPERATIONS DIVISION, APPLIED TECHNOLOGY BRANCH, MATERIALS ANALYSIS SECTION OF QUALITY AND RELIABILITY ASSURANCE LABORATORY
Murl H. Newberry 15 Apr. 1971 28 p
(NASA-TM-X-64587) Avail NTIS CSCL 09B

The feasibility of utilizing a digital computer system to support the development and exercise of various engineering and scientific activities that will be conducted by the Analytical Operations Division, Applied Technology Branch, Materials Analysis Section of Quality and Reliability Assurance Laboratory was examined. The functions of this system will include: (1) real time monitoring and controlling of test procedures; (2) acquisition of data in real time to support chemical kinetic testing; (3) acquisition of infrared data for compounds testing; (4) acquisition of X-ray diffraction data for materials research and testing; (5) performing a quick look analysis of these data; and (6) generation of edited data for off-line detailed analysis. Author

N71-25409 Department of Energy, Mines and Resources, Ottawa (Ontario). Earth Physics Branch.
A MAGNETOGRAM READING MACHINE, VOLUME 41, NO. 3
B. Caner and K. Whitham 1970 19 p refs
Copyright. Avail: Issuing Activity

A hybrid analogue/digital device has been designed for semi-automatic processing of records from magnetic observatories. The machine produces hourlay and daily mean value on final form in a single operation. Output is either on printed sheets suitable for direct photo-offset reproduction, or on punched cards, or on both simultaneously. The machine features high reliability and moderate accuracy (+ or − 1 percent + or − 1 gamma). A significant saving in manpower is achieved by use; three components data for an observatory for one year can be completely processed in about six weeks. One unit has been in operational use since 1962, and seven years of data have so far been successfully processed by this method. Author

N71-25410# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
A FINITE ELEMENT PROGRAM FOR THE ANALYSIS OF RADIAL FLOW IMPELLERS
R. K. Henrywood May 1971 54 p refs
(IC/71/09) Avail: NTIS CSCL 09B

A listing of the program and full details of its use are presented. The idealisation and the data cards are described in detail and an example is included. Guidance is given for transfer of the program to a different machine and various common error messages are listed together with their likely causes. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N71-24397# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
PHOTODETECTORS FOR THE 0.1 MICROMETER TO 1 MICROMETER SPECTRAL REGION
David H. Seib and Lee W. Aukerman 25 Jan. 1971 213 p refs
(Contract F04701-70-C-0059)
(AD-718096; TR-0059-9230-20-1; SAMSO-TR-71-14) Avail: NTIS CSCL 9/1

The state of the art of detectors of electromagnetic radiation in the wavelength region 0.1 micrometer to 1 micrometer is reviewed. The types of detectors considered are photoemissive detectors, semiconductor junction detectors, photoconductors, and photoionization chamber devices. For each type of detector the theory of operation and general material and device properties, including spectral response, frequency response, noise properties, etc., are discussed. The actual properties of presently available, state-of-the-art detectors are summarized. Finally, a comparison of the detectivities possible with the various types of detectors over the 0.1 micrometer to 1 micrometer wavelength range is given. Comparisons of other relevant detector properties (speed of response, reliability) are also included. Author (GRA)

N71-24398# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
ELECTRICAL POWER REQUIREMENTS Final Report
28 Dec. 1970 13 p

(AD-719099; MTP-6-3-517) Avail: NTIS CSCL 10/2

Test methods are described for the determination of communication-electronic equipment power requirements and the compatibility of such equipment with designated power sources. Author (GRA)

N71-24418# Army Electronics Command, Fort Monmouth, N.J.

MODE CONTROL AND RELATED STUDIES OF VHF QUARTZ FILTER CRYSTALS

Theodore J. Lukaszek Nov. 1970 32 p refs

(AD-719175; ECOM-3363) Avail: NTIS CSCL 9/5

Criteria for designing filter crystals with minimum disk diameter and maximum electrode diameter for the achievement of high quality, unwanted mode free AT-cut VHF filter crystals below 150 MHz has been reported previously. The technique used was to consider certain inherent boundaries on resonator design and performance arising from the intrinsic properties of quartz and on the diameter and thickness of the electrode in accordance with trapped-energy concepts. At frequencies above 150 MHz, however, such conventionally used crystal designs result in units possessing either an increasingly higher content of unwanted modes and/or resistance values normally greater than acceptable for most equipment applications. The purpose of the paper is to present new information which alleviates previously encountered restrictions and permits fabrication of filter crystals to frequencies as high as 200 MHz. This has been made possible on the basis of first, a recently assembled crystal plating and monitoring system and secondly, the introduction of a new processing method employing ion-etch techniques. Author (GRA)

N71-24448# Northeastern Univ., Boston, Mass.

INVESTIGATION OF SOLID STATE DEVICES AND DESIGN OF ELECTRONICS AND ELECTRO-OPTICAL MEASURING EQUIPMENT Final Report, 1 Oct. 1967 – 30 Sep. 1970

Basil L. Cochrun 30 Sep. 1970 42 p refs

(Contract F19628-68-C-0114)

(AD-719740; AFCRL-70-0703) Avail: NTIS CSCL 9/1

The investigations carried consisted of an attempt to find unique applications for the SCAD-Small Current Amplifying Device-, a new semiconductor device similar to the J-FET; a search for low-noise devices and the design of low noise preamplifiers suitable for new solid state sensors; a study of electrolumenescence in Ge; and a study of the anomalous behavior of Schottky junctions. Author (GRA)

N71-24486# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

QUALITATIVE ELECTROMAGNETIC INTERFERENCE Final Report

18 Dec. 1970 12 p

(AD-719098; MTP-6-3-513) Avail: NTIS CSCL 14/2

The Army service test procedure describes test methods and techniques for determining the presence of electromagnetic interference and its qualitative effect upon communication-electronic equipment when collocated with other equipment being operated normally. The evaluation is related to criteria expressed in applicable qualitative materiel requirements (QMR), small development requirements (SDR), technical characteristics (TC) or other appropriate design requirements and specification. Author (GRA)

N71-24487# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.

RECORDING AND REPRODUCING EQUIPMENT, TAPE Final Report

22 Dec. 1970 14 p

(AD-719097; MTP-6-3-245(c)) Avail: NTIS CSCL 14/3

The document is a guide to test methods and techniques for determining the suitability of tape recording and reproducing equipment for tactical use by the Army. Author (GRA)

N71-24556# European Organization for Nuclear Research, Geneva (Switzerland). Machine Div.

AN INSTRUMENT FOR MEASURING THE RATE OF CHANGE OF THE RF FREQUENCY IN PARTICLE ACCELERATORS

F. Blandamura, R. Giannini, A. Susini, and C. Zanaschi 29 Sep. 1970 22 p refs

(CERN-70-28) Avail: AEC Depository Libraries

An electronic device is described which measures the time derivative of a time-dependent frequency function. There are systematic and random errors; the latter can be decreased significantly if f(t) is periodic as in the case of particle accelerators. The device has been constructed to monitor the accelerating frequency program of the CERN Synchro-cyclotron (SC) and it allows a relative accuracy better than 2.5 percent. Author (NSA)

N71-24587# Naval Research Lab., Washington, D.C.

REPORT OF NRL PROGRESS, MARCH 1971

Mar. 1971 37 p refs

Avail: NTIS

Conversion of a manually operated antenna to a digital autotracking antenna system and design of a continuous wave TRAPATT diode are discussed. Problems are briefly reviewed concerning high pressure piezoelectric ceramic hydrophone, fatigue behavior of glass filament-wound epoxy composites in water, optimal distribution of passive sensors for underwater detection, hydrogen assisted cracking in high strength Ti-6Al-4V alloy, and strain hardening vs. stress relaxation effects on fatigue crack propagation. J.A.M.

N71-24588# Naval Research Lab., Washington, D.C. Space Applications Branch.

CONVERSION OF A MANUALLY OPERATED ANTENNA TO A DIGITAL AUTOTRACKING ANTENNA SYSTEM

George E. Price *In its* Rept. of NRL Progr. Mar. 1971 p 1–8 refs (See N71-24587 13-09)

Avail: NTIS

A systematic approach was made to the design of a digital autotracking antenna system. Azimuth and elevation information for two antennas is stored in binary form on paper tape. The tape is read by a controller, which reformats and transmits the digital data at specific time intervals to a digital-to-synchro converter for each antenna. The converter outputs synchro position data through the previously existing manual command unit to the pedestal drive circuitry in a servo control loop. Author

N71-24589# Naval Research Lab., Washington, D.C. Solid State Technology Branch.

DESIGN OF CW TRAPATT DIODES

A. C. MacPherson *In its* Rept. of NRL Progr. Mar. 1971 p 9–12 refs (See N71-24587 13-09)

Avail: NTIS

The factors that may limit the size and therefore the maximum cw power output of microwave diode sources are examined. A theory of thermally limited diodes is developed, and the implications are discussed briefly for tunnel diodes, the GEISHA, and the TRAPATT. A design procedure for the TRAPATT diode is outlined, and an example is carried out. Shallow junctions, diamond heat sinking, and low diode power dissipation density are seen to favor large power output. Author

N71-24595* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ELECTROMAGNETIC POLARIZATION SYSTEMS AND METHODS Patent

Ralph E. Taylor, inventor (to NASA) Issued 10 Nov. 1970 (Filed 10 Jan. 1969) 15 p Cl. 343-7.5; Int. Cl. H04b7/10; Int. Cl.

G01s9/22
(NASA-Case-GSC-10021-1; US-Patent-3,540,045; US-Patent-Appl-SN-790420) Avail: US Patent Office CSCL 09E

The polarization tilt angle of linearly polarized electromagnetic waves is determined by converting the linearly polarized waves into a pair of oppositely sensed circularly polarized waves, having a relative electrical phase difference indicative of the polarization tilt angle. The phase difference between the circularly polarized waves is determined with a feedback network including a phase shifter responsive to one of the circularly polarized waves and a detector for deriving an output indicative of the ratio of the difference of the phase shifted. A system for at will controlling the polarization directions of circularly and linearly polarized electromagnetic waves includes a pair of hybrids. A sum output port of the first hybrid is coupled through a variable phase shifter to a port of the second hybrid, while a difference output of the first hybrid is coupled to another port of the second hybrid. The transmitter and receiver are combined with a five-element monopulse antenna array and a monopulse diversity polarization receiver.

Official Gazette of the U.S. Patent Office

N71-24596* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HIGH SPEED PHASE DETECTOR Patent
Gary L. Parker, inventor (to NASA) Issued 28 Apr. 1970 (Filed 26 Sep. 1967) 4 p Cl. 328-133; Int. Cl. H03b3/04; Int. Cl. H03d13/00 Continuation-in-part of US Patent Appl. SN-343428, filed 7 Feb. 1964 Sponsored by NASA
(NASA-Case-XNP-01306-2; US-Patent-3,509,475; US-Patent-Appl-SN-684083) Avail: US Patent Office CSCL 09E

A high speed phase detector is described which is comprised of Exclusive OR input unit to which two square wave signals are applied as input signals. The positive state of the output signal of the input unit is a function of the phase relationship between the two input signals. A bootstrap integrator, to which the output signal of the input unit is supplied, provides a linear ramp voltage output signal which is initiated and terminated by the beginning and end, respectively of the positive state of the output signal of the input unit. A hold circuit is supplied with samples of the voltage provided by the integrator when the output signal of the input unit changes from a positive to a negative state.

Official Gazette of the U.S. Patent Office

N71-24597* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TRANSDUCER CIRCUIT AND CATHETER TRANSDUCER Patent
Dean R. Harrison and William J. Kerwin, inventors (to NASA) Issued 8 Dec. 1970 (filed 12 Sep. 1968) 9 p Cl. 73-398; Int. Cl. G01i9/12
(NASA-Case-ARC-10132-1; US-Patent-3,545,275; US-Patent-Appl-SN-759460) Avail: US Patent Office CSCL 09E

An improved transducer circuit is described which has a pair of impedance means each energized with a like carrier voltage of opposite polarity. At least one impedance means includes a variable impedance element adapted for external influence whereby a differential output voltage is produced proportional to such influence. The circuit requires only one coaxial cable for energization and return of output so as to be particularly directed to highly miniaturized devices, and the invention includes a catheter transducer incorporating this circuit.

Official Gazette of the U.S. Patent Office

N71-24618* Nortronics, Palos Verdes Peninsula, Calif.
FLEXIBLE CONDUCTIVE DISC ELECTRODE Patent
Frank B. Ramme, inventor (to NASA) Issued 15 Dec. 1970 (Filed 29 Aug. 1968) 5 p Cl. 128-2.06; Int.-Cl. A61b5/04 Sponsored by NASA
(NASA-Case-FRC-10029; US-Patent-3,547,105; US-Patent-Appl-SN-760389) Avail: US Patent Office CSCL 09E

A dry, electrode is described which features a wire sandwiched between two discs cut from sheets of a flexible conductive material. The electrodes are made by mixing silver powder with a cement, diluting the mixture with a suitable solvent for the cement and applying it in a thin layer to a surface from which it can be removed as a film when dry; cutting or shaping the dried film to form the size electrodes desired; placing a wire lead on the cut film piece; applying a small amount of solvent to the film surface having the wire thereon, and pressing a second piece of the dried film thereto to form the electrode. Official Gazette of the U.S. Patent Office

N71-24715*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SOLDER-CIRCUITRY SEPARATION PROBLEMS ASSOCIATED WITH PLATED PRINTED CIRCUIT BOARDS
A. M. Pesciak May 1971 47 p refs Prepared in cooperation with SPACO, Inc.
(Contract NAS8-20081; 933-50-07-00-62)
(NASA-TM-X-2290; M655) Avail: NTIS CSCL 09E

This report covers a detailed investigation of the problems of solder-circuitry separation associated with plated printed circuit boards. Gold and copper platings were studied and various circuitry conditions were evaluated, including tinned laminate copper, plated copper with brightener additives over laminate copper, and gold overplate. The laboratory test program included a technical survey, failure analyses, metallographic examinations, chemical analyses, and thermal conditioning. Factors pertinent to the separation mechanism were isolated and aging/strength studies were performed.

Author

N71-24717* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PULSE RISE TIME AND AMPLITUDE DETECTOR Patent
Murrel D. Slayden and Hugh W. Staley, inventors (to NASA) Issued 24 Nov. 1970 (Filed 16 Nov. 1967) 6 p Cl. 324-181; Int. Cl. G04f9/00
(NASA-Case-XMF-08804; US-Patent-3,543,159; US-Patent-Appl-SN-683606) Avail: US Patent Office CSCL 09E

An apparatus for detecting pulses which exceed a specified rise time from a first to a second amplitude including an input buffer for receiving the pulse and for simultaneously applying it to a gate generator and to a delay generator is described. The gate generator output is coupled to an AND gate and functions to open the AND gate for a time period equal to the specified rise time after the incoming pulse has reached the first amplitude. The delay generator output is also connected to the AND gate and functions to produce a pulse at the time that the incoming pulse exceeds the second amplitude. If the AND gate is still being held open by the presence of the gate generator pulse when the delay generator pulse arrives, this pulse will pass through the AND gate and will be indicative of a no-go condition.

Official Gazette of the U.S. Patent Office

N71-24800* National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
SATURATION CURRENT PROTECTION APPARATUS FOR SATURABLE CORE TRANSFORMERS Patent
Francisc C. Schwarz, inventor (to NASA) Issued 10 Nov. 1970 (Filed 14 Nov. 1968) 8 p Cl. 321-45; Int. Cl. H02m7/52; Int. Cl. H03k3/26
(NASA-Case-ERC-10075; US-Patent-3,539,905; US-Patent-Appl-SN-775870) Avail: US Patent Office CSCL 09F

A saturation current protection apparatus for saturable core transformers is reported. A cut core (air gap) transformer detects the occurrence of rapidly increasing magnetic current in the saturable core transformer. When a rapidly increasing current condition occurs, the cut core transformer applies a suitable signal to a switching means. The switching means terminates the application of current to the saturable core transformer to protect it from an

undesirable over current condition.

Official Gazette of the U.S. Patent Office

N71-24803* Stanford Research Inst., Menlo Park, Calif.

MAGNETIC POWER SWITCH Patent

Edwin K. van De Riet, inventor (to NASA) Issued 17 Nov. 1970 (Filed 31 Jul. 1968) 5 p Cl. 307-88; Int. Cl. G11c11/08 Sponsored by NASA Prepared for JPL

(NASA-Case-NPO-10242; US-Patent-3,541,346; US-Patent-Appl-SN-749181) Avail: US Patent Office CSCL 09A

A magnetic power switch is disclosed which comprises a transfluxor-type magnetic core, with a major and a minor aperture. The state of the switch is controlled by controlling the direction of flux about the major aperture. Separate decoupled power sources and power loads are coupled to two core legs, one of which is between the major and minor aperture and the other between the minor aperture and the core periphery. The switch is turned on by setting the flux in one of these legs. The leg is cleared when power is transferred from the source to the load coupled thereto, at the same time setting the flux in the other leg, which is cleared when power is transferred from the source, to the load coupled there.

Official Gazette of the U.S. Patent Office

N71-24804* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ELECTRONIC SCANNING OF 2-CHANNEL MONOPULSE PATTERNS Patent

Richard F. Schmidt, inventor (to NASA) Issued 10 Nov. 1970 (Filed 25 Jun. 1969) 5 p Cl. 343-100; Int. Cl. H01q3/26

(NASA-Case-GSC-10299-1; US-Patent-3,540,050; US-Patent-Appl-SN-836367) Avail: US Patent Office CSCL 09E

A monopulse scanning network suitable for scanning a two channel, three dimensional volumetric antenna pattern, such as an equiangular spiral antenna pattern is described. The scanning network is formed of a phase shifter and a weighting circuit. The weighting circuit comprises a pair of 90 degree or quadrature hybrids and an intermediate phase shifter. The signals from the two channels are applied to the network and the phase shifter shifts one of the signals so that the relative phase difference between the two signals is reduced to zero or pi radians. The intermediate phase shifter is then adjusted to reduce one of the two channel signals to zero and increase the other to a maximum value.

Official Gazette of the U.S. Patent Office

N71-24805* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SYSTEM FOR MAINTAINING A MOTOR AT A PREDETERMINED SPEED UTILIZING DIGITAL FEEDBACK MEANS Patent

Clayton Loyd, inventor (to NASA) Issued 8 Dec. 1970 (Filed 6 Sep. 1968) 5 p Cl. 318-318; Int. Cl. H02p5/06

(NASA-Case-XMF-06892; US-Patent-3,546,553; US-Patent-Appl-SN-757875) Avail: US Patent Office CSCL 09C

A control system for maintaining a motor constant at a prescribed speed is described. The system involves a feedback generator and a variable control oscillator. A countdown and referencing circuit is provided for counting down the control pulses to the desired frequency and is designed to be reset to zero on the occurrence of each feedback pulse. The outputs of the feedback generator and countdown and referencing circuit are fed to a detector circuit. The detector is arranged to produce a first output voltage level signal on the occurrence of a pulse from the countdown and referencing circuit and a second output voltage level signal if two pulses arrive from the feedback generator before another pulse arrives from the countdown and referencing circuit. The detector is designed to drive an output motor control which supplies power to the motor in accordance with the output voltage level of the detector circuit to return the motor to the prescribed speed.

Official Gazette of the U.S. Patent Office

N71-24806* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

REMODULATOR FILTER Patent

Howard C. Vivian, inventor (to NASA) Issued 22 Dec. 1970 (Filed 24 Apr. 1968) 5 p Cl. 328-165; Int. Cl. H03b1/04 Sponsored by NASA

(NASA-Case-NPO-10198; US-Patent-3,550,023; US-Patent-Appl-SN-723804) Avail: US Patent Office CSCL 09E

An apparatus is disclosed for filtering an input signal to obtain the components of a particular frequency and phase. The apparatus comprises a pair of capacitors, each having a first side coupled directly to the output and coupled through a common resistor to the input. The apparatus also includes a switch which alternately connects the second side of each capacitor to ground to enable the capacitors to alternately charge toward the input signal level during alternate half cycles of the switch frequency.

Official Gazette of the U.S. Patent Office

N71-24807* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

POWER SYSTEM WITH HEAT PIPE LIQUID COOLANT LINES Patent

Ambrose W. Byrd, inventor (to NASA) Issued 3 Nov. 1970 (Filed 28 Aug. 1969) 7 p Cl. 165-105; Cl. 165-107; Cl. 165-138; Cl. 310-4; Int. Cl. F28d15/00; Int. Cl. H02n3/00 Continuation-in-part of US Patent Appl. SN-706013, filed 16 Feb. 1968

(NASA-Case-MFS-14114-2; US-Patent-3,537,515; US-Patent-Appl-SN-854815) Avail: US Patent Office CSCL 09E

A power system having a number of thermionic diodes connected in parallel is described. The diodes use heat pipes as cathodes. The system employs a circulatory cooling system utilizing liquid metal coolant lines which are heated by a series of heat pipes butted end to end and extending through the center of the lines.

Official Gazette of the U.S. Patent Office

N71-24808* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

BROADBAND MICROWAVE WAVEGUIDE WINDOW Patent

Charles T. Stelzried and Donald L. Mullen, inventors (to NASA) Issued 10 Dec. 1968 (Filed 27 Dec. 1966) 4 p Cl. 333-98 Sponsored by NASA

(NASA-Case-XNP-08880; US-Patent-3,416,106; US-Patent-Appl-SN-605094) Avail: US Patent Office CSCL 09E

A description is given of a broadband waveguide window arrangement which compensates for the capacity distribution effect of dielectric material in standard waveguide sections. The window's major function is to prevent the narrowing of the bandwidth of the waveguide section. This is accomplished by narrowing the width of the section to be filled with a pair of conductive metallic strips or shims placed adjacent each narrow wall.

E.H.W.

N71-24841* Metcom, Inc., Salem, Mass.

TUNING ARRANGEMENT FOR AN ELECTRON DISCHARGE DEVICE OR THE LIKE Patent

Vincent J. Martucci, inventor (to NASA) Issued 17 Nov. 1970 (Filed 17 Jan. 1968) 6 p Cl. 333-83; Int. Cl. H01p7/06; Int. Cl. H01j23/20 Sponsored by NASA Prepared for JPL

(NASA-Case-XNP-09771; US-Patent-3,541,479; US-Patent-Appl-SN-698630) Avail: US Patent Office CSCL 09E

A tuning arrangement is described consisting of a tuning sleeve with a tuning element attached to one end. The alignment and rigidity of the sleeve are controlled by a retainer to which a bellows is fastened to provide a vacuum seal. The bellows retainer and sleeve are designed to allow free movement of the sleeve within the vacuum without galling. Attached to the other end of the sleeve is a tuning shaft which is axially movable by means of rotatable gears. A locking arrangement eliminates gear backlash and provides a positive locking force on the shaft after tuning in order to maintain the positioning under conditions of severe vibration and shock.

D.L.G.

N71-24842* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

BROADBAND MODIFIED TURNSTILE ANTENNA Patent

Paul H. Lemson, inventor (to NASA) Issued 8 Dec. 1970 (Filed 1 Dec. 1969) 5 p Cl. 343-797; Int. Cl. H01q21/26 (NASA-Case-MSC-12209; US-Patent-3,546,705; US-Patent-Appl-SN-881039) Avail: US Patent Office CSCL 09E

An antenna is described consisting of an essentially planar structure having a series of interconnected rod-like components which include two resonant half-wave dipole elements and four delta matching feeder elements. The feeder elements cooperate with the dipole elements in the antenna structure to form a half-wave wire slot. The wire slot may be dimensioned to establish a desired input impedance to the antenna element, and two antenna elements may be combined and fed in phase quadrature to develop circular polarization. D.L.G.

N71-24843* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

APPARATUS FOR DETERMINING THE DEFLECTION OF AN ELECTRON BEAM IMPINGING ON A TARGET Patent

Edward L. Shriver, inventor (to NASA) Issued 17 Nov. 1970 (Filed 27 Jul. 1967) 5 p Cl. 324-71; Int. Cl. G01r27/00 (NASA-Case-XMF-06617; US-Patent-3,541,439; US-Patent-Appl-SN-656993) Avail: US Patent Office CSCL 09E

An apparatus is described for determining an electric field strength by measuring the deflection of an electron beam passing through the electric field. It includes a generally cross-shaped target on which a thin conductive layer is placed for dividing the beam current in direct ratio to the point of beam impingement from current tapping connections coupled to the four edges of the conductive layer. A series of amplifiers are used for amplifying the currents obtained and a recorder measures the difference between the amplified currents from diametrically opposed current tapping connections. Official Gazette of the U.S. Patent Office

N71-24882# National Aviation Facilities Experimental Center, Atlantic City, N.J.

TECHNICAL EVALUATION OF DUAL INPUT TRANSPONDER Final Report, Jul. 1969 - May 1970

Jules E. Blazej Apr. 1971 78 p refs (FAA-NA-71-39; FAA-RD-71-18) Avail: NTIS

The Dual Input Transponder (DIT) was evaluated to determine if it, in conjunction with upper and lower aircraft antennas, could resolve existing Air Traffic Control Radar Beacon System (ATCRBS) antenna coverage problems by minimizing aircraft antenna shielding phenomena. Flight tests of the DIT and other comparative transponder-antenna configurations were conducted and included several types of manuevers intended to place the test aircraft in numerous shielding attitudes. Results of the test program indicated that the DIT effectively minimized the loss of transponder replies caused by shielding of the antennas and provided essentially uninterrupted antenna coverage. A limited number of tests with two independently operated transponders and two antennas indicated that this configuration resulted in less apparent shielding effects than the DIT system. Author

N71-24883*# Martin Marietta Corp., Denver, Colo.

LINEAR MODULATOR Final Report

Mar. 1971 37 p (Contract NAS8-25987) (NASA-CR-103116; MCR-71-81) Avail: NTIS CSCL 09E

The design, theory of operation, alignment procedures are discussed for a single channel breadboard modulator, demodulator, and phase locked loops. The breadboard is capable of modulating and demodulating quadrature double sideband suppressed carrier signals operating with channel frequencies from 4 kHz to 200 kHz and modulation frequencies from dc to 16 kHz. The breadboard was tested and successfully passed the test requirements. Recommendations for future development of FDM systems are included. Author

N71-24892* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

DRIVE CIRCUIT FOR MINIMIZING POWER CONSUMPTION IN INDUCTIVE LOAD Patent

William E. Crawford, inventor (to NASA) Issued 22 Dec. 1970 (Filed 19 Aug. 1969) 6 p Cl. 317-148.5; Cl. 307-104; Cl. 317-123; Int. Cl. H01h47/32 Sponsored by NASA (NASA-Case-NPO-10718; US-Patent-3,549,955; US-Patent-Appl-SN-851394) Avail: US Patent Office CSCL 09A

A circuit is described for driving an inductive load, such as a solenoid, so as to minimize the solenoid power consumption. The circuit parameters are selected to apply a driving voltage to the solenoid until the solenoid current exceeds the pull-in current. The circuit automatically terminates the driving voltage and the current through the solenoid is permitted to decay to a value just exceeding the drop-out current. The circuit continues to cycle on and off to alternately drive current through the solenoid and permit it to decay while always maintaining the solenoid current in excess of the drop-out current but considerably below the pull-in current. This cycling continues until the solenoid activate switch is opened. Official Gazette of the U.S. Patent Office

N71-24893* National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

UNSATURATING SATURABLE CORE TRANSFORMER Patent

Francisc C. Schwarz, inventor (to NASA) Issued 17 Nov. 1970 (Filed 4 Nov. 1968) 7 p Cl. 323-56; Int. Cl. H02p13/12; Int. Cl. H02m3/32 (NASA-Case-ERC-10125; US-Patent-3,541,428; US-Patent-Appl-SN-773029) Avail: US Patent Office CSCL 09E

An unsaturating magnetic core is described for use in transformers in electrical power processing equipment. The unsaturing core comprises two separate cores that operate in parallel. The function of the composite core transformer is described as part of a common parallel inverter within a dc to dc conversion system. The composite core is designed such that impending saturation of the core causes a warning signal to be generated which is then used to terminate current conduction in the primary circuit. Official Gazette of the U.S. Patent Office

N71-24904* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

BRUSHLESS DIRECT CURRENT TACHOMETER Patent

Frank J. Nola, inventor (to NASA) Issued 17 Nov. 1970 (Filed 28 Aug. 1969) 6 p Cl. 310-10; Int. Cl. H02k (NASA-Case-MFS-20385; US-Patent-3,541,361; US-Patent-Appl-SN-853716) Avail: US Patent Office CSCL 09A

A dc tachometer is disclosed utilizing Hall effect crystals to achieve brushless commutation. A crystal is placed at the center of a pole defined by each of the armature windings of an alternator having a permanent magnet rotor. The Hall effect crystals are positioned to be responsive along a first axis to the flux generated by the permanent magnet and have a second axis perpendicular to the first axis electrically connected to the armature windings so as to be responsive to the current induced in the armature winding upon rotation of the rotor. The output voltages of the Hall effect crystals appearing on the axis perpendicular to the first and second axes are summed to obtain a voltage proportional to the speed of the rotor that is independent of rotor position. Official Gazette of the U.S. Patent Office

N71-25084# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HIGH POWER ELECTRONICS

P. L. Kapitsa et al 29 Dec. 1970 210 p refs Transl. into

ENGLISH from Elektron. Bolshikh Moshchnostei (USSR), no. 6, 1969 p 1–192
(AD-719778; FTD-HC-23-263-70) Avail: NTIS CSCL 9/5

The volume, publishes articles describing the powerful superhigh frequency generators of the magnetron type developed in the Physics Laboratory, the nigotron. A detailed description is given of the construction of the nigotron and all the installations, the calculations involved and the results of experimental investigations. This is followed by articles devoted to the study of the stability of the generation operation in the nigotron and the investigation of the field structure in the working space and in all the resonator systems of the nigotron. Industry has developed a nigotron in the form of a device with independent vacuum. A description is given of its development. It includes articles devoted to the general theories of generators, among them, those of the magnetron type. We also present a theoretical work devoted to a new type of steady acceleration of the electrons in the microtron. The volume concludes with the investigation of effective wave guide systems in which a dielectric is used instead of metal, and the description of wavemeters operating on the same principle. Such a wavemeter may be used in the millimeter and the submillimeter bands. Author (GRA)

N71-25167# Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
RADIATION FROM CIRCUMFERENTIAL SLOTS ON PLASMA CLAD CONES Technical Report, Jan. Oct. 1970
Gordon E. Stewart, Kurt E. Golden, and David C. Pridmore-Brown 26 Feb. 1971 37 p refs
(Contract F04701-70-C-0059)
(AD-719739; TR-0059(6220-10)-9; SAMSO-TR-71-37) Avail: NTIS CSCL 9/5

The radiation pattern distortion produced by a high-altitude, boundary-layer plasma is investigated for both symmetically and asymmetrically excited circumferential slot antennas on models of conical reentry vehicles that use an electric discharge simulation of the sheath. The slot configurations are selected to conform to nose-mounted telemetry antennas in current use, and the peak electron densities and electron density profiles are selected to approximate high-altitude reentry conditions. Measured patterns and theoretical predictions are compared for both bare and plasma-clad cones. These indicate large modifications of the radiation pattern in the forward direction, even for relatively thin and underdense plasmas. Author (GRA)

N71-25202# Aerospace Corp., El Segundo, Calif. Lab. Operations.
SELF AND MUTUAL ADMITTANCES FOR AXIAL RECTANGULAR SLOTS ON A CYLINDER IN THE PRESENCE OF AN INHOMOGENEOUS PLASMA LAYER
Gordon E. Stewart and Kurt E. Golden 30 Jan. 1971 18 p refs
(Contract F04701-70-C-0059)
(AD-719736; TR-0059(6220-10)-5; SAMSO-TR-71-38) Avail: NTIS CSCL 9/5

The analysis of self and mutual admittances for axial rectangular slots in an echelon configuration for a cylinder clad with a radially inhomogeneous plasma is presented. The isolation between E-plane coupled slots for cylinders of different radii clad with a typical, low-altitude reentry plasma is compared with ground-plane-based calculations for the same plasma conditions. Author (GRA)

N71-25227# Booz-Allen Applied Research, Inc., Bethesda, Md.
A GENERALIZED LITE CYCLE COST MODEL FOR ELECTRONIC EQUIPMENT
10 Mar. 1970 158 p
(Contract DAAB07-69-D-5041)
(AD-719709) Avail: NTIS CSCL 5/1

The purpose of the study is to develop a generalized life cycle cost model that can be employed by analysts of the Systems/Cost Analysis Office (S/CAO) as an aid in the development of cost estimates for electronic equipment. The model developed has a structure of cost aggregation that lends itself to the data format in which information is available and concurs with the anticipated data collection format to be used by the Cost Information Division. The Life Cycle Cost Handbook included in this document was developed to provide a consistent set of definitions for cost information to be collected. It also contains references to data sources and CERs identified in the early literature review. The method of data collection developed and the computerized model assure that studies using the model and the handbook will produce estimates predicated upon a consistent approach that is fully documented. This will permit the analyst to expend the bulk of his effort in data collection and analysis. Author (GRA)

N71-25228# Sandia Corp., Albuquerque, N.Mex.
PERMANENT NEUTRON DAMAGE IN PIN MICROWAVE DIODE SWITCHES
R. J. Chaffin Dec. 1970 44 p refs
(SC-RR-70-853) Avail: NTIS

The microwave PIN diode and its associated circuitry were studied both experimentally and theoretically. The results show that microwave PIN switches are very susceptible to permanent neutron damage. The failure mechanism is a severe reduction of conductivity modulation in the I region of the diode caused by a reduction of carrier lifetime. This loss of conductivity modulation not only causes a reduction of the isolation abilities of a microwave switch, but also leads to other secondary failure modes that can be extremely important. Author (NSA)

N71-25250*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IMPROVED PARASITIC SPEED CONTROLLERS FOR SPACE POWER SYSTEMS
H. L. Wimmer and B. D. Ingle [1971] 15 p refs Proposed for presentation at 1971 Intersoc. Energy Conversion Eng. Conf., Boston, 3–6 Aug. 1971; sponsored by SAE
(NASA-TM-X-67834) Avail: NTIS CSCL 22B

The dynamic space power systems considered use parasitic speed controllers to regulate the rotational speed and frequency of the alternators. The present controllers employing phase-controlled loading have performance characteristics that could be improved. Design concepts for modifications of control logic as ways to improve these characteristics are discussed and evaluated. Modifications investigated include: (1) an increase in the number of stages for a given load range with each stage controlling a reduced amount of parasitic load, (2) the addition of active nonlinear networks and power feedback networks, and (3) a design employing only digital circuitry in which a discrete amount of parasitic load would be varied for a discrete change in frequency. The results of the investigation indicate that the largest improvement in the electrical performance characteristics of the power systems is obtained by using an all-digital speed controller. However, an important limitation is that the digital speed controller requires the use of a relatively large number of parasitic load elements. Author

N71-25308*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE DEVELOPMENT OF A MAGNETICALLY SUSPENDED MOTOR FOR ATTITUDE CONTROL DEVICES
Philip A. Suder *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 225–228 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 09E

An engineering model of an electronically commutated dc motor with a magnetically suspended rotor is described. The model has a 6-lb rotor suspended by a pair of symmetrical, cylindrical

electromagnets, and an 8-oz-in. torque capability; it operates at speeds up to 10,000 rpm with very low rotational losses. G.G.

N71-25316*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ADVANCED LOW NOISE PARAMPS
Pio H. Dalle Mura *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 256-258 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 09E

Design and construction of a miniaturized integrated solid state prototype parametric amplifier for use in a tracking and data relay spacecraft is described. The microstrip circuit operates in a broadband fixed-tune mode covering the 2.2- to 2.3-GHz frequency band; its basic structure includes a ferrite circulator and varactor circuitry. Performance tests on the integrated preamplifier established a 240 hour gain stability within plus or minus 0.2 dB and a noise temperature better than the design specification of 150 K. G.G.

N71-25389*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF NUCLEAR RADIATION ON A HIGH RELIABILITY SILICON POWER DIODE. 3: JUNCTION CAPACITANCE
Julian F. Been, Ira T. Myers, and Michael P. Godlewski Washington May 1971 19 p refs
(NASA-TN-D-6330; E-5946) Avail: NTIS CSCL 09A

The effects of nuclear radiation on the junction capacitance of a 35 A, 600 PIV n(+)-p-p(+) power diode was determined for fast neutron fluences up to 4.6 × 10 to the 13th power neutrons/sq cm. Capacitance changes ranging from a small decrease to as much as 50 percent increase were found for small reverse biases. These changes are probably due to channel formation. At large reverse biases, the junction capacitance remained essentially unchanged with radiation. Author

N71-25407# Bendix Corp., Kansas City, Mo.
ELECTRICAL CONNECTION STUDY
R. D. Wagner Sep. 1970 18 p
(Contract AT(29-1)-613)
(BDX-613-204) Avail: NTIS

Uniform low values of contact resistance between metal eyelets and thin aluminum coatings on a glass-reinforced epoxy or Mylar substrate were required for a special assembly. Nine joining methods which were investigated failed to produce the desired connection quality. Pulse arc welding, however, appeared the most promising. Author (NSA)

N71-25408# Radio Corp. of America, Princeton, N.J. Electro-Optics Lab.
INVESTIGATION OF SOLID STATE COLD CATHODES
Elliott S. Kohn 10 Dec. 1970 27 p
(Contract F19628-70-C-0235)
(AD-719718; Scientific-2; AFCRL-70-0711) Avail: NTIS CSCL 9/1

Silicon cold cathodes were successfully operated for the first time. Planar structures were operated at efficiencies as high as 0.0005 while Si:SiO2 structures had efficiencies as high as 0.3%. Pulsed currents as large as 0.6 mA were drawn, corresponding to current densities in excess of 100 mA/sq cm. The silicon cold cathodes were also operated continuously, and it was found that tens of microamperes could be drawn for several hours, and encouraging result from the viewpoint of practical devices. The procedure for fabricating and testing Si:SiO2 cold cathodes is discussed, and methods are proposed for achieving more efficient operation. Author (GRA)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see specific Physics categories.

N71-24798* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MULTIALARM SUMMARY ALARM Patent
James D. Heckelman, inventor (to NASA) Issued 8 Dec. 1970 (Filed 17 Apr. 1967) 6 p Cl. 340-412; Int. Cl. G08b19/00
(NASA-Case-XLE-03061-1; US-Patent-3,546,694; US-Patent-Appl-SN-632152) Avail: US Patent Office CSCL 09C

An alarm circuit having an indicating device which becomes activated by the opening of a gate circuit having two signal inputs is reported. One of the gate signal inputs is connected to a plurality of fault contact sets. A normally conducting semiconductor switch is connected to the other gate signal inputs. The semiconductor switch is connected through respective pulse forming networks to the fault contact sets in order that the conduction of the semiconductor switch will be briefly interrupted each time a fault contact set closes. Official Gazette of the U.S. Patent Office

N71-24799* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SWITCHING CIRCUIT Patent
Carl P. Chapman and Donald R. Rupnik, inventors (to NASA) Issued 17 Mar. 1970 (Filed 29 Jun. 1966) 5 p Cl. 307-254; Int. Cl. H03k17/00 Sponsored by NASA
(NASA-Case-XNP-06505; US-Patent-3,501,648; US-Patent-Appl-SN-562933) Avail: US Patent Office CSCL 09C

A solid state switching circuit is disclosed in which AC signals at an input terminal are switched to an output terminal through a gating transistor, as a function of the transistor's state of conduction. The state of conduction is controlled by controlling the DC potential difference between its emitter and base and by means of a pair of control transistors, forming part of a DC control circuit. The relative states of conduction of the control transistors which produce the potential difference are controlled as a function of the amplitude of a DC control signal. Official Gazette of the U.S. Patent Office

N71-24844* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
NOISE LIMITER Patent
Raymond C. Woodbury, inventor (to NASA) Issued 17 Nov. 1970 (Filed 30 Jan. 1968) 7 p Cl. 328-171; Int. Cl. H03k5/08 Sponsored by NASA
(NASA-Case-NPO-10169; US-Patent-3,541,459; US-Patent-Appl-SN-701733) Avail: US Patent Office CSCL 09C

A circuit for limiting the peak excursions of random noise inputs to a level proportional to the average input is described. The circuit comprises a pair of diodes for clipping the positive and negative peaks of an input signal, and a capacitor charged by the input signal for back biasing the diodes to a value proportional to the average input signal. The capacitor voltage is applied to the diodes through operational amplifiers, to provide a low impedance path for currents passing through the diodes. Official Gazette of the U.S. Patent Office

N71-24861* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
TRANSISTOR SERVO SYSTEM INCLUDING A UNIQUE DIFFERENTIAL AMPLIFIER CIRCUIT Patent
James R. Currie and Frank J. Nola, inventors (to NASA) Issued 4 Aug. 1970 (Filed 20 Dec. 1968) 7 p Cl. 318-599; Int. Cl. G05b11/28
(NASA-Case-XMF-05195; US-Patent-3,523,228; US-Patent-Appl-SN-785595) Avail: US Patent Office CSCL 09C

The servo system incorporates an error generating network which energizes a pulse width modulator for converting the error signal into a pulse train for driving a servo amplifier. The output of the servo amplifier is used to energize a reversible motor for balancing the error generating network. A pulse width modulator is provided having a differential mode input and a differential mode output to obtain temperature stability and is operated as a crossover detector so as to make the system insensitive to variations of the peak amplitudes of the linear sweep voltage near null.
Official Gazette of the U.S. Patent Office

N71-24862* Spacelabs, Inc., Van Nuys, Calif.
PEAK POLARITY SELECTOR Patent
Stephen K. Shepard, inventor (to NASA) Issued 24 Nov. 1970 (Filed 30 Oct. 1968) 8 p Cl. 307-235; Int. Cl. H03k5/20 Sponsored by NASA
(NASA-Case-FRC-10010; US-Patent-3,543,050;
US-Patent-Appl-SN-771937) Avail: US Patent Office CSCL 09C

Apparatus is disclosed for monitoring an alternating signal, such as an electrocardiograph waveform, to select the polarity of greatest peak amplitude with respect to a specified dc level and to transmit to a utilization device, such as a cardiotachometer, only that part of the waveform above or below that level which has the greatest peak amplitude. A signal presence detection circuit enables the peak polarity selection to be made automatically by comparing the absolute values of peak voltages of the two polarities and setting a flip-flop accordingly. The flip-flop then selectively enables an output switch for transmitting to an output terminal the polarity of greatest amplitude, but inverted if necessary to provide an output signal with a predetermined polarity.
Official Gazette of the U.S. Patent Office

N71-24863* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RC RATE GENERATOR FOR SLOW SPEED MEASUREMENT Patent
William M. McCampbell and Clayton Loyd, inventors (to NASA) Issued 15 Oct. 1968 (Filed 22 Jun. 1966) 6 p Cl. 324-70 Continuation-in-part of US Patent Appl. SN-516795, filed 27 Dec. 1965
(NASA-Case-XMF-02966; US-Patent-3,406,336;
US-Patent-Appl-SN-560968) Avail: US Patent Office CSCL 09C

A slow speed measuring system including first and second RC rate generators, each consisting of a continuous rotation potentiometer having their respective resistors connected across a dc source and their wiper arms coupled to capacitors is discussed. The wiper arms are driven in accordance with the speed to be measured and are angularly displaced from one another. Switching means responsive to the position of the wiper arms are provided for alternately coupling the outputs of the RC rate generators to current indicating means so as to maintain the current indicating means connected to the RC rate generator operating in its continuous interval. Additional switching means are provided to discharge the respective capacitors after disconnection with the current indicating means and to connect the output of the RC rate generator not connected to the current indicating means to current conducting means.
Official Gazette of the U.S. Patent Office

N71-24902*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ACTIVE TUNED CIRCUIT Patent Application
Leonard L. Kleinberg, inventor (to NASA) Filed 18 Jan. 1971 27 p
(NASA-Case-GSC-11340-1; US-Patent-Appl-SN-107379) Avail: NTIS CSCL 09C

The design of an active tuned circuit is described particularly suitable for microelectronic construction as filters, amplifiers, and oscillators for operation near the transitional frequency of the transistors employed. A high Q, tunable network is attained by coupling a second bipolar transistor configuration to the emitter of a first bipolar transistor in order to provide negative resistance and capacitive reactance as necessary to tune the low Q inductive value of the first bipolar transistor.
NASA

N71-25139* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PULSE WIDTH INVERTER Patent
Harry Reid, Jr. and James R. Currie, inventors (to NASA) Issued 30 Dec. 1969 (Filed 25 Jan. 1968) 7 p Cl. 321-9; Int. Cl. H02m1/12
(NASA-Case-MFS-10068; US-Patent-3,487,288;
US-Patent-Appl-SN-700541) Avail: US Patent Office CSCL 09C

An apparatus for converting dc to ac voltage by utilizing varying pulse widths is described. All of the pulses are arranged so that when filtered a sine wave output is obtained. A polyphase system can be created by using a combination of two pulse trains for each phase desired with all pulses being generated by the same clock circuit and arranged by a selector device.
Official Gazette of the U.S. Patent Office

N71-25140# Brown Univ., Providence, R.I. Div. of Applied Mathematics.
A SYNTHESIS PROCEDURE FOR PARAMETER ADAPTIVE CONTROL SYSTEMS
A. E. Pearson, Krishna-Sastry V. R. Vanguri Mar. 1971 38 p refs
(Grants AF-AFOSR-693-67; NSF GK-24485)
(AD-719838; AFOSR-TR-71-0493) Avail: NTIS CSCL 12/1

Given a plant with differential equations characterized by a parameter vector w which is unknown and slowly varying with time, and given a corresponding feedback controller with equations characterized by an adjustable parameter vector y, a synthesis procedure is presented which leads to a closed loop adaptive control system for adjusting y in the face of drift variations in w. The steps in the synthesis procedure involve the structuring of the basic control system such that model matching is possible for an optimal choice in y corresponding to every $w, y^* = y^*(w)$, a selection of a performance index $p(y, y^*)$ which has the properties of metric function on every adjustment interval, and the derivation of a modified gradient for updating the value of y which can be implemented on-line during the normal course of system operation. An example of a pitch rate orientational control system is used to illustrate the synthesis procedure, and the results of a computer simulation study of the over-all adaptive system are discussed which include the effects of nonlinearities, disturbance and measurement noises, as well as time variations in the unknown w parameters.
Author (GRA)

N71-25390*# Arizona Univ., Tucson. Dept. of Electrical Engineering.
A DISTRIBUTED LUMPED ACTIVE BIQUADRATIC NETWORK FUNCTION REALIZATION
L. P. Huelsman Mar. 1971 26 p refs
(Grant NGL-03-002-136)
(NASA-CR-118338) Avail: NTIS CSCL 09C

The use of a simple distributed lumped active network configuration which can be used to give a dominant pole approximation to a biquadratic voltage transfer function with complex left half-plane poles and complex zeros is discussed. Design charts and example network realizations are given.
Author

N71-25391*# Electronic Communications, Inc., St. Petersburg, Fla.
STUDY TO DEVELOP PROCESS CONTROLS FOR LINE CERTIFICATION ON HYBRID MICROCIRCUITS Final Report, Nov. 1970 – Feb. 1971
R. A. Rossmeisl and S. Riskowitz 1971 122 p
(Contract NAS8-26381)
(NASA-CR-103126) Avail: NTIS CSCL 09C

The basic process steps utilized in the fabrication of thick or thin film hybrid microcircuits and the measurements, tests, and inspections required to maintain consistent control of these process steps are presented. The testing methods, tolerances, and inspection criteria are based on proven experience in pilot and low volume production of high reliability hybrid microcircuits. Remedial action procedures are indicated in the event tolerances are exceeded. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N71-24395*+ Spectrolab, Inc., Sylmar, Calif.
ENGINEERING STUDY: CHAMBER 'D' SOLAR SIMULATOR Progress Report
R. W. Basil and A. C. Brown 22 Jan. 1971 73 p
(Contract NAS9-11114)
(NASA-CR-114968; Rept-3718) Avail: NTIS CSCL 14B

The feasibility of fitting the B chamber xenon source module into the D chamber solar simulator was studied. The geometric considerations for the successful interchange of optical components, and the anticipated test volume were investigated for mechanical interchange of the two source units. It is concluded that the interchange of source modules does not present an optical problem, and the B chamber xenon solar module can be utilized to provide a one solar constant irradiance within the D chamber. F.O.S.

N71-24675# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
THE IMPERIAL COLLEGE GRAPHITE HEATED HYPERSONIC WIND TUNNEL
J. K. Harvey, R. W. Jeffery, and D. C. Uppington Jan. 1971 46 p refs Sponsored by Min. of Aviation Supply
(IC-AERO-71-01) Avail: NTIS

The design and development of a graphite heated, continuous running, Mach 20 wind tunnel, which operates with Reynolds numbers between 6 x 10,000 and 5 x 1,000,000 per meter, are described. Preliminary calibrations are presented for a contoured and a conical nozzle and for the performance of the centerbody diffuser. An electron beam probe is used to measure test section conditions. Author (ESRO)

N71-24700# Royal Aircraft Establishment, Farnborough (England).
SPUTTER YIELDS FROM TITANIUM AND TANTALUM IN A 1.5 kV MERCURY ION ENGINE BEAM
B. P. Day Aug. 1970 32 p refs
(RAE-TR-70149) Copyright. Avail: NTIS

Variation of sputter yield from titanium and tantalum has been measured with respect to incident angle of 1.5 kV mercury ions, with a view to determining their suitability as target material for an ion engine test facility. Neither has the resistance to sputter damage that had been hoped for, but, since other materials are even less resistant, it is suggested that they are preferable to other common engineering materials. For comparison, a few measurements were made for silicon carbide, zinc, and brass. Author (ESRO)

N71-24957# Test Group (6585th) Holloman AFB, N.Mex.
SLED DESIGN TECHNIQUES Final Report
Larry C. Mixon Feb. 1971 470 p refs
(AD-719751; AFSWC-TR-71-3) Avail: NTIS HC $6.00/MF $0.95 CSCL 14/2

Rocket sleds are commonly used for simulation of special environments for testing purposes. The motion of a sled on the track induces large quasi-steady state and dynamic forces on the sled. Design of sleds requires knowledge of these forces and of established techniques for the application of measured and theoretical forcing functions to proven mathematical structural simulations. Multicomponent force transducers were developed and designed as an integral part of a sled structure. An extensive measurements program was conducted on the high speed test track using these newly developed transducers. A modeling program was conducted to establish the accuracy with which lumped mass-stiffness computer programs can model a sled. A nonlinear rigid body computer model, with provisions for adding secondary mass systems, was developed to simulate rocket sled motion. Random analysis techniques were then applied to the sled linear computer models. These design techniques were organized into recommended design procedures for rocket sleds. Author (GRA)

N71-24964* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE SIMULATOR Patent
James B. Stephens, inventor (to NASA) Issued 13 May 1969 (Filed 5 Oct. 1967) 7 p Cl. 62-55.5; Int. Cl. F25b41/00; Int. Cl. B64g7/00; Int. Cl. B01d5/00 Sponsored by NASA
(NASA-Case-NPO-10141; US-Patent-3,443,390; US-Patent-Appl-SN-673227) Avail: US Patent Office CSCL 14B

An apparatus, which is practical for commercial laboratory situations, is described for simulating space environments. The device is used to study the effects of space on spacecraft components. Official Gazette of the U.S. Patent Office

N71-24985* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
FLAMMABILITY TEST CHAMBER Patent
Carlos L. Springfield, William J. Paton, and John D. Jeter, inventors (to NASA) Issued 8 Dec. 1970 (Filed 30 Jul. 1969) 5 p Cl. 73-15; Int. Cl. G01n25/00
(NASA-Case-KSC-10126; US-Patent-3,545,252; US-Patent-Appl-SN-845973) Avail: US Patent Office CSCL 14B

A lammability test chamber for testing materials in predetermined environments includes an elongated chamber having a transparent hermetically sealed shield adjacent one end. A plurality of cutouts are carried on the other end with a rupture disk positioned over one of said cutouts which prevents build up of pressure within the chamber beyond a given level. The chamber can be evacuated by a vacuum pump and gas can be inserted therein to produce a desired environment. A probe extends through the wall of the chamber for rotating an implement carried on the end thereof, as well as moving such forward and backward during a test. Another objective is to determine if certain mechanical movements of an apparatus will create a spark to ignite the material. Official Gazette of the U.S. Patent Office

N71-25124# California Univ., Berkeley. Lawrence Radiation Lab.
BEVATRON OPERATION AND DEVELOPMENT, 64. OCTOBER–DECEMBER 1969
Kenneth C. Crebbin, Robert Frias, and Hermann A. Grunder 6 Mar. 1970 9 p refs
(Contract W-7405-eng-48)
(UCRL-19720) Avail: NTIS

The Bevatron provided beam to 18 experiments this quarter and during two months of operation accelerated 2.4×10 to the 18th power protons. Light experiments were completed. Resonant extraction studies are reported, and the plans to make the system operational are discussed. Also, the new computer control system for the main motor generators is discussed. Author (NSA)

N71-25229# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
THE CAL SHOCK TUBE DRIVEN MOLECULAR BEAM

CROSSED BEAM SCATTERING Final Scientific Report, Dec. 1969 – Nov. 1970
George T. Skinner Dec. 1970 35 p refs
(Contract F44620-70-C-0018)
(AD-719820; CAL-AI-2913-A-1; AFOSR-TR-71-0076) Avail: NTIS CSCL 14/2

The use of the CAL shock-tube-driven molecular beam, in conjunction with its target beam and mass spectrometer, to measure scattered intensity at various angles from the main beam axis is reported. A 2.2 eV argon beam was fired into both argon and nitrogen target beams. The test chamber can be held at pressures in the low 10 to the –9th torr range. The mass spectrometer can be operated at very high sensitivity, but it exhibits a slow response which has been traced to the ionizer and is a function of emission current. The use of the mass spectometer is a detector of atoms scattered from a solid surface, and as a gas sampler for main beam composition studies, are also reported.
Author (GRA)

N71-25333*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
BROADENING OF SPECTRAL LINES IN A SOLAR SIMULATOR HIGH PRESSURE ARC
Mathew P. Thekaekara *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 320–323 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

Quantum mechanical theory of the mercury atom and statistical theory of the plasma are used to analyse line profiles in high pressure mercury-xenon lamps used as radiant energy sources in space environment simulators. Quantitative analyses made on about 20 lines at five power levels varying between 500 and 2800 W show a strong dependence on the input power and on the upper and lower levels involved in the transitions related to Lorentz broadening, Doppler broadening, and quadratic Stark effect broadening. It is concluded that observed effects yield information on the temperature, ion density, and other parameters of the mercury-xenon plasma.
G.G.

N71-25341*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DIGITAL TAPE UNIT TEST FACILITY DEVELOPMENT AND APPLICATIONS
William C. Webb *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 354–359 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

A digital tape unit test facility is described that consists of a seven track digital tape driver analyzer equipment and the computer programs necessary to measure the performances of seven track digital tape drives recording at 200, 556, and 800 bits per inch. The software features and functions performed by four computer programs are: (1) a read skew analysis program for test tapes generated on the tape drive analyzer; (2) a routine test tape generator program to write worst case data and to block length patterns; (3) a set of general support programs for performance evaluation of recorded digital tapes; and (4) management report preparation programs to interpret results from routine tape testing program.
G.G.

N71-25375# Australian National Univ., Canberra. Inst. of Advanced Studies.
ACCEPTANCE CALCULATIONS FOR THE AUSTRALIAN NATIONAL UNIVERSITY MODEL EN (HVEC) TANDEM ACCELERATOR
N. H. Merrill and S. Whineray [1970] 15 p refs
(ANU-P/506) Avail: NTIS

Details are reported of the phase space acceptance, determined by trajectory calculations of one type of accelerator in use at many laboratories: the High Voltage Engineering Corporation Model EN Tandem Van de Graaff machine.
Author

N71-25376# von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
A DESCRIPTION OF THE VKI PISTON DRIVEN SHOCK TUBE
M. J. Lewis Dec. 1970 32 p refs
(VKI-TM-20) Avail: NTIS

The mechanical construction of a piston driven shock tube is described. The gas supply system, the electronic control system, and the operating procedure for this device are also presented.
Author

N71-25425*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
FUNDAMENTAL TECHNIQUES OF WEIGHT ESTIMATING AND FORECASTING FOR ADVANCED MANNED SPACECRAFT AND SPACE STATIONS
Willie Heineman, Jr. Washington May 1971 52 p refs
(NASA-TN-D-6349; MSC-S-256) Avail: NTIS CSCL 14B

A readily applicable fundamental tool for weight estimating and forecasting is presented for use by managers, planners, and engineers during the concept-definition phase of a manned-spacecraft or space-station program.
Author

N71-25546*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MSC CONTAMINATION CONTROL PROGRAM REQUIREMENTS MANUAL VOLUME 2: GOVERNMENT FURNISHED EQUIPMENT CLEANLINESS REQUIREMENTS
Sep. 1970 10 p
(NASA-TM-X-67154; MSCM-5322-Vol-2) Avail: NTIS CSCL 14B

The minimum cleanliness and packaging requirements for Government furnished equipment are presented. Cleanliness levels described herein do not supersede any more stringent controls that may be required from medical, biological, or system standpoints for spacecraft onboard equipment and precision clean packaging.
Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N71-24399# Ballistic Research Labs., Aberdeen Proving Ground, Md.
THEORETICAL TEMPERATURE DISTRIBUTION IN THE PRECURSOR REGION AHEAD OF PROJECTILES TRAVELING AT HYPERSONIC VELOCITIES
Wallace Henry Clay Dec. 1970 69 p refs
(AD-718641; BRL-MR-2084) Avail: NTIS CSCL 20/4

An attempt is made to obtain order-of-magnitude estimates of the radiant intensity profiles for the precursor region of a gas, ahead of a hypervelocity shock wave. An approximate expression for the temperature distribution in the precursor is derived for the case where gamma is very large. The parameter, gamma, appears in the nondimensionalization of the flow equations. The importance of radiative heat transfer relative to convective heat transfer is characterized by the size of gamma. The approximation for the temperature is then used to predict the radiant intensity profile in the precursor for a specific example. The values of the parameters used for the calculation were chosen from a prior experiment in which the profile was measured.
Author (GRA)

N71-24431# Air Force Academy, Colo. Frank J. Seiler Research Lab.
NONEQUILIBRIUM RADIATIVE GASDYNAMICS OF POINTED BODIES
David Finkleman Feb. 1971 28 refs Presented at the Heat Transfer and Fluid Mech. Inst., Jun. 1970 p 258–277
(AD-719744; SRL-TR-71-0001) Avail: NTIS CSCL 20/4

The effects of chemical and radiative nonequilibrium upon high speed gas flows are quite different. These differences have been documented for blunt bodies with detached shock waves. More interesting slender body flows with inherent multi-dimensional radiative fields have received little attention. Herein expressions are derived for shock curvature at the tip of any wedge or cone in a radiating gas flow. Flow fields downstream of straight shock waves are investigated, and a class of exact solutions of the coupled equations of two dimensional radiative gasdynamics is found. Body shapes which generate straight shock waves are determined, and several important differences between radiative gasdynamics and chemically coupled gasdynamics in this situation are noted. Because the solutions obtained are restricted only in that the shock wave must be attached to the tip of the body, regimes of Mach number and body slope heretofore unexplored can be examined. Author (GRA)

N71-24434# National Aeronautical Establishment, Ottawa (Ontario).
THE INCOMPRESSIBLE LAMINAR BOUNDARY LAYER OVER A SLENDER BODY OF REVOLUTION AT SMALL INCIDENCE
T. R. F. Nonweiler Apr. 1970 442 p refs
(AD-719535; NAE-LR-532; NRC-11665) Avail: NTIS CSCL 20/4

The work investigated the incompressible flow within the boundary layer of a body of revolution at incidence, using slender body theory to describe the inviscid flow field. The calculations were made by digital computer, using adaptive procedures to keep close control of truncation errors. The results obtained confirm previously published expectations of the state of the flow. Author (GRA)

N71-24476# Case Western Reserve Univ., Cleveland, Ohio. Div. of Fluid Thermal and Aerospace Sciences.
LIQUID GAS SEPARATION AND CONTAINMENT
Minor Nice and Simon Ostrach Aug. 1970 121 p refs
(Grant AF-AFOSR-1581-68)
(AD-718992; FTAS/TR-70-49; AFOSR-70-2259TR) Avail: NTIS CSCL 14/2

The paper considers the separation and containment of a liquid-gas mixture in a closed cyclone separator. A set of performance curves giving the measure of containment as a function of Reynolds number for various separator geometries is presented. Special attention is given to the effect of geometric factors on the development of secondary flows within the separator, and results are presented which give the pressure drop across the separator as a function of Reynolds numbers for various modes of operation. Author (GRA)

N71-24477# ARO, Inc., Arnold Air Force Station, Tenn.
FINAL RESULTS OF ON LINE MASS SPECTROMETRIC ANALYSIS OF NONEQUILIBRIUM AIRFLOWS Final Report, 1 Jul. 1969–30 Jun. 1970
W. W. Mac Dermott and R. E. Dix AEDC Feb. 1971 55 p refs
(Contract F40600-71-C-0002)
(AD-718955; AEDC-TR-71-23) Avail: NTIS CSCL 20/4

Comprehensive determinations of nonequilibrium airflow compositions were made in frozen expansions of arc-heated air in a low-density wind tunnel nozzle. Reservoir conditions included pressures of from 3.7 to 20.8 atm and temperatures of from 2120 to 5380K. The experimentally determined compositions were correlated with the reservoir entropy. At low entropy, the concentrations of molecular species were generally in close agreement with predictions based on finite rate expansion calculations, but at high entropy, where nonequilibrium effects are large, considerable deviations from the predictions were observed. The molecular oxygen content was determined to be 7 percent greater than expected. The atomic oxygen concentration was determined to be consistently less than the theoretical prediction for all values of entropy, by as much as 9 percent of the total sample in the worst case. Author (GRA)

N71-24478# Naval Academy, Annapolis, Md. Dept. of Engineering.
ON THE INTRINSIC REPRESENTATION OF FLOWS WITH LAMB SURFACES Final Report
Stephen L. Passman Aug. 1970 31 p refs Presented at the Southeastern Conf. on Theoretical and Appl. Mech. (5th), Apr. 1970
(AD-719431; USNA-E-70-7) Avail: NTIS CSCL 20/4

Recent results on intrinsic geometry of flows are applied to flows with Lamb surfaces. Author (GRA)

N71-24480# ARO, Inc., Arnold Air Force Station, Tenn.
FREE TURBULENT MIXING: A CRITICAL EVALUATION OF THEORY AND EXPERIMENT Final Report, Jun. 1969–Jun. 1970
Philip Thomas Harsha AEDC Feb. 1971 683 p refs
(Contract F40600-71-C-0002)
(AD-718956; AEDC-TR-71-36) Avail: NTIS HC $9.00/MF $0.95 CSCL 20/4

The problem of the analysis of free turbulent mixing is complex, and some empiricism is always necessary to obtain a solution. This has led to a proliferation of experiments and of semi-empirical models for the turbulent shear stress. All of these models will correlate experimental data well in some region of a particular flow, but not in others. The ultimate goal of the study is to confront each important model for the turbulent shear stress with as broad a range of experimental data as possible. From this confrontation come two sets of conclusions--one detailing those models presently suitable for engineering use, and the second establishing the models which show promise of becoming more generally applicable with further development. Author (GRA)

N71-24482# National Physical Lab., Teddington (England). Aerodynamics Div.
THE BEHAVIOUR OF THE LEADING-EDGE VORTICES OVER A DELTA WING FOLLOWING A SUDDEN CHANGE OF INCIDENCE
N. C. Lambourne, D. W. Bryer, and J. F. M. Maybrey London Aeron. Res. Council 1970 47 p refs Supersedes NPL-AERO-1294; ARC-31056
(ARC-R/M-3645; NPL-AERO-1294; ARC-31056) Copyright. Avail: NTIS; HMSO: £1.25; BIS: $4.50

The transient behavior of leading-edge vortices over a delta wing subject to a sudden change of incidence is of importance in understanding the wing loadings that can occur in unsteady conditions of flight. In the experiments reported changes of incidence have been imposed on delta-shaped plates by application of a constant-velocity plunging motion for a limited time; other related unsteady motions are discussed in the appendix. Cine records of particle tracks and of dye filaments in a water tunnel have been analyzed to trace the time history of vortex centres in cross-flow planes following the application of step-changes of incidence. The flows for various combinations of initial incidence, planform, plunging velocity, and chordwise position have been examined. Results indicate that after the start of the plunge an effectively steady vortex system is established over the plate in a time approximately equal

to that required for one chord length of relative forward travel. Where comparisons can be made, Dore's theoretical calculations of the manner in which the vortices move show fair agreement with the experiment. Effects of the transient movements of the vortices on lift distribution are discussed and the inference is drawn that the changes in the distribution of wing loading occurring for an increase of incidence are not simply reversed when the incidence is decreased. Author (ESRO)

N71-24491# Northrop Corp., Hawthorne, Calif. Aircraft Div.
A WIND TUNNEL INVESTIGATION OF JETS EXHAUSTING INTO A CROSSFLOW. VOLUME 4: ADDITIONAL DATA FOR THE THREE JET CONFIGURATION
Lynn B. Fricke, Peter T. Wooler, and Henry Ziegler Wright-Patterson AFB, Ohio AFFDL Dec. 1970 200 p
(Contract F33615-69-C-1602)
(AD-718123; AFFDL-TR-70-154-Vol-4) Avail: NTIS CSCL 20/4

A low speed wind tunnel test of a four-foot diameter circular plate model with up to three exhausting jets was conducted to determine surface static pressure distributions, jet paths, and jet decay characteristics in the presence of a crossflow. Three-jet configuration data were obtained with the jets exiting normal to the plate for a number of velocity ratios and sideslip angles. As a result of this investigation, several conclusions are deduced pertaining to the interaction of multiple jets exhausting into a crossflow. Author (GRA)

N71-24492# Northrop Corp., Hawthorne, Calif. Aircraft Div.
A WIND TUNNEL INVESTIGATION OF JETS EXHAUSTING INTO A CROSSFLOW. VOLUME 1: TEST DESCRIPTION AND DATA ANALYSIS
Lynn B. Fricke, Peter T. Wooler, and Henry Ziegler Wright-Patterson AFB, Ohio AFFDL Dec. 1970 448 p refs
(Contract F33615-69-C-1602)
(AD-718122; AFFDL-TR-70-154-Vol-1) Avail: NTIS HC $6.00/MF $0.95 CSCL 20/4

A low speed wind tunnel test of a four-foot diameter circular plate model with up to three exhausting jets was conducted to determine surface static pressure distributions, jet paths, and jet decay characteristics in the presence of a crossflow. Data were obtained for the one-jet configuration with the jet exiting at a number of angles to the plate and at various velocity ratios and sideslip angles. Two-jet arrangements were tested with the jets exiting normal to the plate for three different spacings between the two jets and at a number of velocity ratios and sideslip angles. Three-jet configuration data were obtained with the jets exiting normal to the plate for a number of velocity ratios and sideslip angles. As a result of this investigation, several conclusions are deduced pertaining to the interaction of multiple jets exhausting into a crossflow. The test model, instrumentation, test procedure, and reduction and accuracy of the test data are discussed in this volume. A summary and discussion of the test results are also presented. Author (GRA)

N71-24585*# Techtran Corp., Glen Burnie, Md.
STRUCTURE OF SUPERSONIC STREAM OF ARGON HELIUM MIXTURE IN A VACUUM [STRUKTURA SVERKHZVUKOVOY STRUI APGON GELIYEVOY SMESI V VAKUUME]
A. A. Bochkarve et al Washington NASA May 1971 12 p refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekhn. Fiz. (Moscow), no. 5, Sep.–Oct. 1970 p 58–163
(Contract NASw-2037)
(NASA-TT-F-13583) Avail: NTIS CSCL 20D

An experimental study was conducted of barodiffusion processes in supersonic streams of a mixture of argon and helium using a beam of electrons. The results of the investigation of these effects in gradient streams are presented. Author

N71-24590# Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.
OBSERVATION OF A MECHANISM CAUSING A TRAILING VORTEX TO BREAK UP
J. K. Harvey and J. E. Fackrell Dec. 1970 16 p refs
(IC-AERO-70-08) Avail: NTIS

Simple flow visualization experiments have been performed to identify a new form of vortex breakdown which is characterized by the disturbance appearing somewhere near the edge of the core and not on the vortex center line. There is a marked similarity between the disc observed and those seen in condensation trails. In the experiments a towing tank was used which enabled the vortices to be studied within a frame of reference which was stationary with respect to the undisturbed fluid and so their total history could be observed. Author (ESRO)

N71-24598*# Techtran Corp., Glen Burnie, Md.
THE SPEED OF SOUND IN TWO-PHASE VAPOR-LIQUID SYSTEMS [SKOROST' ZVUKAV DVUKHFAZNYKH PAROZHIDKOSTNYKH SISTEMAKH]
I. S. Radovskiy Washington NASA May 1971 15 p refs Transl. into ENGLISH from Zh. Prikl. Mekh. Tekh. Fiz. (Moscow), no. 5, Sep.–Oct. 1970 p 78–85
(Contract NASw-2037)
(NASA-TT-F-13582) Avail: NTIS CSCL 20D

Total analysis of the combined influence of all processes accompanying propagation of sound on its velocity in two-phase media is performed on the basis of the thermodynamics of irreversible processes. Author

N71-24608*# Techtran Corp., Glen Burnie, Md.
TURBULENT WAKE IN A STRATIFIED MEDIUM [TURBULENTNYY SLED V STRATIFITSIROVANNOY SREDE]
A. T. Onufriyev Washington NASA May 1971 9 p refs Trans. into ENGLISH from Zh. Prik. Mekhan. i Tekh. Fiz. (Moscow), no. 5, Sep.–Oct. 1970 p 68–72
(Contract NASw-2037)
(NASA-TT-F-13580) Avail: NTIS CSCL 20D

The problem is studied of the determination of the form of the turbulent wake formed behind a freely moving body in a medium with density variable in the direction of application of the force of gravity. The study analyzes the problem of the first stage in development of a wake (before collapse), that is the problem of turbulent diffusion in a stratified medium. The medium itself is at rest. The basis for description of the process of diffusion is the equations used to describe anisotropic diffusion. The simplifications usually used in analysis of the problem of propagation of a turbulent wake are used, related to the experimental fact that free turbulent flow zones are relatively narrow. Molecular diffusion is not considered. It is considered that density pulsations are slight, and therefore, they are considered only in the components containing the acceleration of the force of gravity. Author

N71-24619*# Techtran Corp., Glen Burnie, Md.
PROPAGATION CHARACTERISTICS OF WEAK PERTURBANCES IN TWO PHASE MEDIA WITH PHASE TRANSITIONS [OSOBENNOSTI RASPROSTRANENIYA SLABYKH VOZMUSHCHENIY V DVUKHFAZNYKH SREDAKH S FAZOVYMI PEREKHODAMI]
A. I. Ivandayev et al Washington NASA May 1971 10 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Tekhn. Fiz. (Moscow), no. 5, Sep.–Oct. 1970 p 73–77
(Contract NASw-2037)
(NASA-TT-F-13581) Avail: NTIS CSCL 20D

The propagation of weak perturbations in two-phase media, consisting of a mixture of a gas with droplets or particles is studied on the basis of linearized hydromechanic equations considering possible phase transitions. The dependences of the weight vector on

perturbation frequency are produced. The influence of mass transfer between phases on the nature of the dispersion dependences is estimated. Author

N71-24636# Hydronautics, Inc., Laurel, Md.
SOME TECHNIQUES OF EJECTING ADDITIVE SOLUTIONS FOR DRAG REDUCTION
Jin Wu Feb. 1971 27 p refs
(Contract N00014-71-C-0063)
(AD-719375; TR-7101-1) Avail: NTIS CSCL 20/4

Tests of slots (inclined, vertical, and shielded) and porous-type ejectors for introducing additive solutions into an aqueous boundary layer to reduce turbulent frictional resistance are reported. It was found that the slot ejector is better suited for dilute solutions, and that the porous ejector is better suited for concentrated solutions. Compared to the vertical and the shielded slots, the inclined slot introduces far less mixing between the ejected additive solution and the surrounding water. Author (GRA)

N71-24682* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
TRAVERSING PROBE Patent
Edwin J. Saltzman, Meryl D. De Geer, Stanley C. Plamowski, and Robert Grant Green, inventors (to NASA) Issued 20 Sep. 1966 (Filed 25 Jun. 1964) 9 p Cl. 73-389
(NASA-Case-XFR-02007; US-Patent-3,273,399; US-Patent-Appl-SN-378080) Avail: US Patent Office CSCL 20D

An instrument which makes it possible to obtain an accurate boundary layer profile using only a limited number of probes, usually one or two, is described. The instrumentation required for recording and measuring is (1) an instrument for measuring and recording the pressure conditions encountered by each probe, and (2) an instrument for determining and recording the position of the probe with respect to the vehicle surface. Inasmuch as the probes are mounted in a fixed position to a single mast only one instrument is required for probe position even though two probes are employed. Two embodiments of a traversing mechanism for extending and retracting the probe are disclosed.
Official Gazette of the U.S. Patent Office.

N71-24714# Royal Aircraft Establishment, Farnborough (England).
ESTIMATION OF HEAT TRANSFER TO FLAT PLATES, CONES AND BLUNT BODIES
L. F. Crabtree, R. L. Dommett, and J. G. Woodley London Aeron. Res. Council 1970 60 p refs Supersedes RAE-TR-65137; ARC-27233
(ARC-R/M-3637; RAE-TR-65137; ARC-27233) Copyright. Avail: NTIS; HMSO: £1.50; BIS: $5.40

Some general concepts and definitions regarding heat transfer are given. A method is described for calculating the rates of heat transfer to the surface of an ideal flat plate or sharp cone in an airstream at Mach numbers up to 10, for both laminar and fully turbulent boundary layers. A system of predicting heat transfer to blunt-nosed bodies throughout the hypersonic speed range is given for laminar, transitional or turbulent boundary layers. The methods were previously described in data sheets which included comparisons with classified experimental results. Author (ESRO)

N71-24743# ARO, Inc., Arnold Air Force Station, Tenn.
STREAMLINE SWALLOWING BY LAMINAR BOUNDARY LAYERS IN HYPERSONIC FLOW Final Report, Sep. 1969–Jun. 1970
A. W. Mayne, Jr. and J. C. Adams, Jr. AEDC Mar. 1971 45 p refs
(Contract F40600-71-C-0002)
(AD-719748; AEDC-TR-71-32) Avail: NTIS CSCL 22/3

Flow over a cold-wall, 22.5-deg asymptotic half-angle hyperboloid at a free-stream Mach number of 10 and free-stream Reynolds numbers (based on nose radius) of 400, 4000, and 40,000 is considered. Numerical results from a streamline-swallowing, nonsimilar, laminar, boundary-layer analysis are compared with results from classical boundary-layer theory, second-order boundary-layer theory, and a fully viscous shock-layer analysis; the results of the latter are used as a standard of comparison. The major improvement effected by the streamline-swallowing analysis is the inclusion of shock curvature effects on the boundary conditions applied along the outer edge of the boundary layer. Results from the streamline-swallowing boundary-layer analysis agree better with the results of the fully viscous shock-layer analysis, than the classical boundary layer and the second-order boundary-layer results. Reasons for the success of one method and the failure of others are discussed. Author (GRA)

N71-24744# ARO, Inc., Arnold Air Force Station, Tenn.
INVESTIGATION OF FLAT-PLATE ASPECT RATIO EFFECTS ON RAMP-INDUCED, ADIABATIC, BOUNDARY LAYER SEPARATION AT SUPERSONIC AND HYPERSONIC SPEEDS Final Report, 10 Dec. 1969–25 Mar. 1970
J. Don Gray and R. W. Rhudy AEDC Mar. 1971 140 p refs
(Contract F40600-71-C-0002)
(AD-719747; AEDC-TR-70-235) Avail: NTIS CSCL 20/4

An experimental investigation of the effects of flat-plate aspect ratio on both laminar and turbulent boundary-layer separations induced by ramps was conducted at free-stream Mach numbers of 6, 8, and 10. Reynolds numbers, based on flat-plate length, ranged from 0.06 million to 1.0 million (laminar) and from 2.6 million to 9.1 million (turbulent) at near-adiabatic model wall conditions. Local Mach number on the flat plate was varied by pitching the laminar model at all free-stream Mach numbers. Longitudinal surface pressure distributions at several spanwise stations were measured to define the lateral pressure gradients and the spanwise variation of the longitudinal extent of the separation region. Data are presented to support the conclusion that for a flat plate short enough (2.5 in.) to achieve laminar flow reattachment, it is required that the flat-plate aspect ratio be of the order of 3 to be assured of negligible effects induced by the finite span. Author (GRA)

N71-24796 Lehigh Univ., Bethlehem, Pa.
FLOW IN A CONICAL DIFFUSER WITH EXTRACTION OF FLUID AT THE WALL
Joseph Emmet Wolfe (Ph.D. Thesis) 1969 187 p
Avail: Univ. Microfilms Order No. 70-10627

The Neumann boundary value problem posed by the steady flow of an ideal fluid in a conical diffuser with extraction of fluid through a circumferential wall slot, with constant velocity normal to the wall, is solved with use of the Mellin integral transform. The method of solution can also be utilized in the solution of potential flow problems related to conical diffusers with extraction of fluid through multiple slots, with the velocity normal to the wall prescribed for each slot. Dissert. Abstr.

N71-24797 Stanford Univ., Calif.
PROPERTIES OF AN IMPERFECT, INHOMOGENEOUS BOSE GAS
Timothy Charles Padmore (Ph.D. Thesis) 1969 157 p
Avail: Univ. Microfilms Order No. 70-10500

A weakly interacting dilute Bose gas near T=0 is used as a model to discuss interactions of a superfluid with ion-like impurities and other inhomogeneities such as walls and vortices. Static solutions to the nonlinear condensate equation are approximated and exact numerical solutions in various geometries are obtained. Equations for flow past fixed boundaries are developed and applied to the numerical calculation of the flow pattern around, and the induced mass of, moving neutral and charged impurities. The reverse dipolar backflow around sufficiently polarizing ions suggested by approximate calculations is verified and found to occur in situations which may well be relevant to liquid Helium.
Dissert. Abstr.

N71-24810 Syracuse Univ., N.Y.
ATOMIZATION AND DROP SIZE DISTRIBUTION OF POLYMER SOLUTIONS
Kuo-Hui Wang (Ph.D. Thesis) 1969 120 p
Avail: Univ. Microfilms Order No. 70-10403

The atomization of simple non-Newtonian fluids by means of grooved-core nozzles was studied. The drop size distributions determined by sieve analysis were found to obey the square root normal distribution over the range of mean drop sizes from 40 to 370 microns. Unlike previous studies, the mean drop size and the standard deviation were correlated only in terms of nozzle dimensions, operating condition and physical properties of the liquid system. The mean drop size was also correlated with the boundary-layer thickness of the fluid at the nozzle orifice. The drop size distribution data were found to be in good agreement with those reported for organic fluids. Dissert. Abstr.

N71-24811 Purdue Univ., Lafayette, Ind.
DESIGN FOR VIBRATION OF CONTROL MECHANISM OF A FLUID DRIVE
Donald Wright (Ph.D. Thesis) 1969 153 p
Avail: Univ. Microfilms Order No. 80-10665

The vibrational characteristics of a large one-to-one torque ratio fluid drive were studied. Of primary concern was the scoop tube-slidebar assembly which controls the amount of fluid in the rotor and thereby provides a continuously variable speed control. Analytical and experimental design tools were provided for the improvement of system reliability. The experimental techniques were shown to be useful to determine and compare characteristics of a modified to an existing drive. The analytical tool developed is a mathematical model capable of solution with a high speed digital computer showing the effects of particular design changes on the vibrational characteristics. Dissert. Abstr.

N71-24870# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.
FLUID MECHANICAL PROCESSES IN GAS CENTRIFUGES [STROEMUNGSMECHANISCHE VORGAENGE IN GASZENTRIFUGEN]
E. Krause and E. H. Hirschel 1970 170 p refs Partly in GERMAN and partly in ENGLISH Colloq. held at Porz-Wahn, West Ger., 14 May 1970
Avail: NTIS

Design and development of gas centrifuges and their contribution to uranium enrichment in Europe are reported. Numerical solutions of the Navier-Stokes equations for calculating incompressible flow in centrifuges are determined. E.M.C.

N71-24929*# North Carolina State Univ., Raleigh. Dept. of Engineering Mechanics.
EXACT EXPRESSIONS FOR CURVED CHARACTERISTICS BEHIND STRONG BLAST WAVES
Otto Laporte (Michigan Univ., Ann Arbor) and Tien Sun Chang Nov. 1970 20 p refs
(Grant NGL-34-002-084; Contract DAAD05-69-0053; Proj. Themis)
(NASA-CR-111908; TSC-70-3) Avail: NTIS CSCL 20D

A numerical analysis of the curved characteristics of the area behind strong blast waves is presented. The self-similar solution with stratified entropy is the only exact solution of the phenomenon and three sets of characteristic curves are developed for this solution. Author

N71-25037# Royal Aircraft Establishment, Farnborough (England).
INVESTIGATION OF ELECTROHYDRODYNAMIC FLOWS AT HIGH ELECTRIC REYNOLDS NUMBERS [ISSLEDOVANIE ELEKTROGIDRODINAMICHESKIKH TECHENII PRI BOLSHIKH ELEKTRICHESKIKH CHISLAKH REINOLDSA]
V. V. Golosov et al Nov. 1970 19 p refs Transl. into ENGLISH from Zh. Prikl. Mekh. Tekh. Fiz. (Moscow), v. 1, 1969 p 3-10
(RAE-Lib-Trans-1515) Avail: NTIS

An investigation is made of the motion of a medium, consisting of neutral particles and charged particles of one sign, on the assumption that the electric Reynolds number (R sub q = u/bE) is large. The integral for the frozen condition, the Bernoulli and Cauchy-Lagrange integrals are written out, the motion of a fluid in pipe flow is investigated, and the statement of the problem of the boundary layer is given. Author

N71-25039 Catholic Univ. of America, Washington, D.C.
AN EXPERIMENTAL INVESTIGATION OF THE ACOUSTICALLY EXCITED, SUBSONIC, TURBULENT COANDA AIR FLOW FIELD AROUND A CIRCULAR CYLINDER
Richard E. Harkness (Ph.D. Thesis) 1969 143 p
Avail: Univ. Microfilms Order No. 70-8602

Incompressible, turbulent, subsonic Coanda flow of air around a circular cylinder is studied experimentally. Radial and tangential mean velocity profiles are measured at angular location of 60, 70, 90, 120 and 150 deg from the jet outlet slot at a jet exit velocity of 130.6 ft/sec. The same measurements are obtained with sound at a frequency of 600 Hz and at a sound pressure level of 104.5 db re 0.0002 microbar injected normal to the jet as it emanates from the slot. It is found that the mean velocity is lowered in regions near the wall and raised in the outer region of the flow field. Self-similarity is obtained for the radial and tangential mean velocity profiles. Measurements are also made of the Eulerian micro- and integral time scales, the longitudinal and lateral micro- and integral spatial scales. Measurements also show that acoustic excitation increases the turbulence intensity of the flow field. The variation of the Reynolds number of the neutral point with phi is studied. Dissert. Abstr.

N71-25072*# Illinois Univ., Urbana. Dept. of Mechanical and Industrial Engineering.
RECOMPRESSION OF A TWO DIMENSIONAL SUPERSONIC TURBULENT FREE SHEAR LAYER
Wen L. Chow [1971] 14 p refs
(Grant NGL-14-005-140)
(NASA-CR-118331) Avail: NTIS CSCL 20D

A flow model was devised to study the turbulent recompression process associated with a two-dimensional supersonic free shear layer. The flow field was divided into two subregions along the dividing streamline. The external supersonic free stream guides and interacts with the upper viscous layer. A velocity profile of third-degree polynomial was assumed for the upper viscous layer and the pressure difference across this layer was estimated from the normal momentum relationship. Conservation principles were applied and a system of ordinary differential and algebraic equations was obtained. In conjunction with the flow conditions prevailing at the end of the constant pressure jet mixing region, the system of equations may be integrated and solved numerically. For a given flow problem, the correct value of base pressure and the location along the wake boundary where recompression starts were established through iterations until the conditions at the rear stagnation point were satisfied. This procedure of calculations fully illustrated the typical elliptic behavior of all separated flow problems. Calculations for isoenergetic flow cases with thin initial boundary layers were carried out and the results showed good agreement with the experimental data. Author

N71-25073# Advisory Group for Aerospace Research and Development, Paris (France).
REPORT OF THE HIGH REYNOLDS NUMBER WIND TUNNEL STUDY GROUP OF THE FLUID DYNAMICS PANEL
Apr. 1971 24 p refs

(AGARD-AR-35-71) Avail: NTIS

The working group considered transonic wind tunnel performance and operating characteristics required to support evolution of military and civil, aeronautical and aerospace systems during the coming decade. These considerations, along with a review of experience on model testing at transonic speeds, led to the conclusion that the NATO nations should acquire, as soon as possible, two types of new wind tunnels. One tunnel should duplicate transonic flight Reynolds numbers and have a run time on the order of one second. The second should have a 16 ft test section and should provide Reynolds numbers that are 3 or 4 times the maximum presently available, with a run time on the order of 10 seconds. It was also concluded that AGARD should support current research and development in design, operation and test techniques in transonic tunnels of the continuous, conventional blowdown and Ludwieg tube type, and that AGARD should encourage expansion of these activities in the future. Author

N71-25095 Texas Univ., Austin.

GASEOUS DIFFUSION PROCESSES INVOLVING AEROSOL PARTICLES IN NONCONTINUUM REGIMES

James Walter Gentry (Ph.D. Thesis) 1969 300 p

Avail: Univ. Microfilms Order No. 70-10791

An apparatus to measure the slip flow coefficients and the rates of reaction of aerosol particles was constructed. The slip flow coefficient of solid aerosols in mixtures of inert gasses was measured. An equation was derived from the Boltzmann equation for the rate of unipolar charging of aerosols in the free molecule and near free molecule regions. The equation was evaluated numerically for the special case where the interaction between the charged particle and the ions follow Coulomb's law. A comparison between the predictions of the equation and experimental data reported in the literature was made. A criterion for the extension of the method to include more general interaction forces between the particles and the ions was suggested. The equations describing simultaneous heat and mass transfer to an aerosol particle undergoing evaporation or condensation in the transition region were developed. Dissert. Abstr.

N71-25171# General Electric Co., Philadelphia, Pa. Re-entry and Environmental Systems Div.

SHOCK LAYER IONIZATION AT HIGH ALTITUDES Final Report, Nov. 1968 - Jan. 1971

Henry G. Lew Nov. 1970 111 p refs

(Contract F19628-69-C-0112)

(AD-719750; GE-70SD782; AFCRL-70-0702) Avail: NTIS CSCL 20/4

Electron production from the high temperature shock layer of blunt re-entry bodies are considered at high altitudes. The dissociation and subsequent ionization of air species due to the high flight speeds are predicted by analytical techniques with the consideration of the prevalent viscous effects at low density throughout the flow and with chemical relaxation of these species. The effect of vibrational nonequilibrium is also determined. Finally the spatial distributions of air species, temperature, velocity, and electron concentrations over a sphere-cone body, the Trailblazer, is mapped in detail for several altitude velocity conditions. Author (GRA)

N71-25230# Naval Research Lab., Washington, D.C.

A STUDY OF DRAG REDUCTION AND ADSORPTION OF POLYMER SOLUTIONS

P. Peyser, R. C. Little, and C. R. Singleterry 27 Jan. 1971 16 p refs

(AD-719385; NRL-7222) Avail: NTIS CSCL 7/4

A study was made of the adsorption from aqueous solution of polyethylene oxide Polyox and polyacrylamide onto Pyrex, silica, and stainless-steel surfaces. This investigation was undertaken to determine if a correlation exists between the structure of adsorbed polymer films at solid/liquid interfaces and the observed ability of such polymers to reduce the drag in liquid flow systems. In this study the amount of polymer adsorbed by high-surface-area adsorbents was determined by measuring the difference in polymer concentration before and after adsorption. The thickness of adsorbed polymer films on clean, flat surfaces was determined by ellipsometry. It was concluded that Polyox and polyacrylamide molecules adsorbed in thin films, lying relatively flat at the interface with no large loops projecting into the solution. In a parallel study percent drag reduction dr was measured in a rotating disk apparatus. The totality of the evidence suggests that for the systems studied the composition of the surface and polymer adsorption on the surfaces are not related to DR. Author (GRA)

N71-25244# Michigan Univ., Ann Arbor. Coll. of Engineering.

NONLINEAR INTERACTIONS IN ROTATING STRATIFIED FLOW Final Report

S. J. Jacobs Jan. 1971 28 p refs

(Contract Nonr-1224(55))

(AD-719960; Rept-07344-5-F) Avail: NTIS CSCL 20/4

Nonlinear interactions in a rotating, stratified fluid with a free surface are considered. The field variables are expanded in terms of eigenfunctions of the linearized problem, with coefficients dependent on time. Orthogonality relations are developed to obtain evolution equations for the coefficients, and these are simplified through use of the method of averaging for weakly nonlinear motions. The geostrophic mode, which alone possesses potential vorticity, is tested with regard to the quasi-geostrophic equations when wave modes are presented. The phases of the wave modes are affected by the presence of the geostrophic mode, with ferequency splitting for steady geostrophic flow. Resonant interactions between waves are observed for a resonant triad consisting of two external waves and one interval wave. Author (GRA)

N71-25415# National Aerospace Lab., Tokyo (Japan).

ON AN APPROXIMATION OF THE TWO DIMENSIONAL INCOMPRESSIBLE TURBULENT BOUNDARY LAYER

Yoshikazu Ogata 1970 19 p refs In JAPANESE; ENGLISH summary

(NAL-TR-219) Avail: NTIS

An expression for the mean velocity profile of the turbulent boundary layer is discussed. According to this expression, relations between the characteristic parameters of the boundary layer are then constructed and compared with those derived from empirical formulas. The auxiliary equation presented for the calculation of the form parameter is based on the use of the energy integral equation in which the term of the shear stress work integral is evaluated with the assumption of the mixing length concept. This approximation is applicable, in place of existing empirical relations, to the calculation of the turbulent boundary layer developing under an arbitrary pressure gradient. Some numerical examples are illustrated and compared with experimental data published by various authors, together with the calculated results of Head's entrainment equation. Author

N71-25416# National Aerospace Lab., Tokyo (Japan).

FINITE DIFFERENCE CALCULATION FOR TWO DIMENSIONAL NONSTEADY NOZZLE FLOWS

Tomiko Ishiguro 1970 51 p refs In JAPANESE; ENGLISH summary

(NAL-TR-205) Avail: NTIS

Numerical solutions for two dimensional nonsteady inviscid compressible nozzle flows using difference schemes are obtained. Several kinds of difference schemes are empirically examined as means of obtaining the numerical solutions of the flows. It is found that the Lax-Wendroff method with artificial viscosity yields excellent accuracy though it requires a large amount of time for the calculation. Using this method, the air (ideal gas) flows in the down stream region of a throat are investigated numerically. We obtain

four patterns of flows in the down stream region of the outlet of a nozzle: a strong shock wave, a Mach reflection wave, a regular reflection wave and an expansion wave. Author

N71-25417# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
THE PREDICTION OF TURBULENT SWIRLING PIPE FLOW
L. W. Roberts Apr. 1971 34 p refs
(EF/TN/A/37) Avail: NTIS

Comparisons are presented between experimental data and theoretical predictions for swirling incompressible flow in straight pipes. Results are shown for swirl velocity, pressure distributions, wall shear stress and angular momentum decay, all at various axial stations. It was found that is was not possible to obtain accurate predictions using a scalar effective viscosity. The use of a two component viscosity greatly improved the predictions and the results presented were calculated with the aid of directional viscosities. The two viscosities necessary in the calculation of swirling pipe flow were those governing the diffusion of angular momentum and the diffusion of axial momentum, both in the radial direction. The former was computed using a mixing length formulation, the latter from a two equation (k-W) turbulence model. Author

N71-25442# Sandia Corp., Albuquerque, N.Mex. Aero-Fluid Dynamics Div.
BODY FORCE EFFECTS ON THE STABILITY OF A LIQUID FILM
Ali Hasan Nafeh (Aerotherm Corp., Mountain View, Calif.) and William S. Saric Nov. 1970 38 p refs Sponsored by AEC
(SC-RR-70-722) Avail: NTIS

The stability of a liquid film interacting with an external gas is investigated within the long wave approximation. The analysis takes into account the liquid viscosity, surface tension, and velocity profile; the pressure and shear perturbations exerted by the gas on the interface due to the appearance of waves; and on arbitrary oriented body force. The analysis is applied to the cases where the external gas is inviscid and compressible (supersonic as well as subsonic), and is incompressible and viscous. The results show that the axial body force is stabilizing if it is directed opposite to the external gas; otherwise, it is destabilizing. It is found that increasing the gas Mach number is stabilizing in the supersonic case while it is destabilizing in the subsonic case. In both the subsonic and supersonic cases, the analysis shows that increasing the liquid Reynolds number (R) or the mean shear exerted by the gas on the interface is destabilizing. Considering the shear and pressure perturbations of a viscous incompressible external gas, and for a constant mean shear of the external flow, the effect of R on the film stability depends on whether the mean shear is below or above a critical value. Author

N71-25443 + Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
IMPULSIVELY STARTING INCOMPRESSIBLE JET
A. S. C. Ma and K. S. Ong Nov. 1970 30 p refs
(EF/TN/A/28) Avail: NTIS

A finite-difference numerical method of solution for the unsteady equations of impulsively-starting jets has been devised. Predicted flow patterns at various times in terms of stream function, vorticity, and concentration contours are presented for the impinging and the free jet cases. Satisfactory agreement was obtained between the present and the similar-solution results at a large distance downstreams of the jet nozzle for the free jet case. Author

N71-25460*# General Electric Co., Cincinnati, Ohio.
TASK 4 STAGE DATA AND PERFORMANCE REPORT FOR CASING TREATMENT INVESTIGATIONS. EVALUATION OF RANGE AND DISTORTION TOLERANCE FOR HIGH MACH NUMBER TRANSONIC FAN STAGES, VOLUME 1
W. A. Tesch May 1971 203 p ref
(Contract NAS3-11157)
(NASA-CR-82862; GE-R71-AEG-149-Vol-1) Avail: NTIS CSCL 20D

Two high-tip-speed compressor stages were tested with various rotor tip casing treatment configurations under conditions of undistorted inlet flow, tip-radial distortion and circumferential distortion. The first stage consisted of a 1400 ft/sec tip speed medium-aspect-ratio rotor plus a stator vane row; the second stage had a 1500 ft/sec tip speed medium-aspect-ratio rotor and a stator vane row. This second stage was tested both with and without zero-turning inlet guide vanes. Overall performance and stall margin were determined for each stage configuration and inlet condition at 70, 90, 100% of design speed. Extensive surveys of flow conditions were made for the case of circumferential distortion. In addition, blade element data were obtained when testing with undistorted and radial distortion inlet conditions. The techniques and procedure used to acquire the data are described and an analysis and discussion of the test results is included. Author

N71-25461*# General Electric Co., Cincinnati, Ohio.
TASK 4 STAGE DATA AND PERFORMANCE REPORT FOR CASING TREATMENT INVESTIGATIONS. EVALUATION OF RANGE AND DISTORTION FOR HIGH MACH NUMBER TRANSONIC FAN STAGES, VOLUME 2
W. A. Tesch May 1971 333 p ref
(Contract NAS3-11157)
(NASA-CR-82867; GE-R71-AEG-149-Vol-2) Avail: NTIS CSCL 20D

Tabulations are presented of blade element and circumferential distortion flow survey data. For description of test see N71-25460. Author

N71-25462# Sandia Corp., Albuquerque, N.Mex.
THE NECESSARY CONDITION FOR THE DETACHMENT (SEPARATION) OF A 3-DIMENSIONAL BOUNDARY LAYER
G. M. Bam-Zelikovich 1970 16 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gazo (Moscow), no. 2, 1970 p 109–113 Sponsored by AEC
(SC-T-71-3007) Avail: NTIS

Shortcomings of previously proposed views on the separation or detachment line of a three-dimensional boundary layer. On the basis of an analysis of phenomena arising during the separation, it was found that the detachment of a three-dimensional boundary layer takes place on the streamlined surface of the line upon which the boundary lines of the flow are perpendicular to the pressure gradient. The possible configurations of the reverse flow zone in a three-dimensional boundary layer are examined. Author

N71-25530# National Aerospace Lab., Tokyo (Japan).
NUMERICAL TESTS ON LAX-WENDROFF DIFFERENCE SCHEME WITH ARTIFICIAL VISCOSITY AND ITS VARIATION BY THE TWO STEP METHOD
Takayuki Aki 1970 27 p refs In JAPANESE; ENGLISH summary
(NAL-TR-217) Avail: NTIS

Results of test computations on the Lax-Wendroff difference scheme and its two variations by the two-step method are described. All of these methods include the so-called artificial viscosity which plays an important role in preventing nonlinear instabilities. The primary goal of these tests was to make a numerical check on the stability condition which was proposed in the literature. A series of test computations was performed over a range of values of the viscosity coefficient. It was found that allowable values of the mesh ratio in the computations were always in excess of the values predicted by the proposed condition and were not so strongly dependent on the viscosity coefficient. Secondly, as a representative of flow variables, the shapes of pressure curves were

examined in relation to the mesh ratios and the magnitudes of the viscosity coefficient. In the case of small values of the viscosity coefficient (1.0 to 2.0) and larger but not the largest possible values of the mesh ration, shapes with the most damped oscillation could be obtained. The usefulness of these difference schemes to analyze multiple interaction of the gas dynamic discontinuities can be also shown by sample computations for the problems of end wall reflection in a shock tube or head-on collision of two shock waves. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N71-24391# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SEISMIC DISCRIMINATION Semiannual Technical Summary Report, 1 Jul. – 31 Dec. 1970
David Davies 31 Dec. 1970 67 p refs
(Contracts F19628-70-C-0230; AF 49(638)-1763; ARPA Order 512)
(AD-718971; ESD-TR-70-416) Avail: NTIS CSCL 17/10

The report contains research on source characteristics, propagation path effects and array processing. The long-period characteristics of explosions are examined and tested against theoretical models. Short period worldwide data are used for a network study of a set of Eastern Kazakh events. A new computer program is being used to trace rays through heterogeneous structures. A detailed study of a Chinese event is given with particular reference to the impact that subsurface structure has on different discriminant tests. The spectraforming process is described and its impact on discrimination discussed. New facilities and the daily Lincoln bulletin are described. Author (GRA)

N71-24392# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
JOINT ADJUSTMENT OF GRAVIMETRIC AND SATELLITE DATA IN THE DETERMINATION OF THE EARTH'S GRAVITATIONAL FIELD [SOUMESTNOE URAVNIVANIE GRAVIMETRICHES KIKH I SPUTNIKOV YKH DANNYKH PRI OPREDELENII GRAVITATSIONNOGO POLYA ZEMLI]
L. P. Pellinen Sep. 1970 26 p refs Transl. into ENGLISH from Byull. Sta. Opt. Nablyudeniya Iskusstvennykh Sputnikov Zemli (USSR), no. 55, 1969 p 58 – 68
(AD-715152; ACIC-TC-1650) Avail: NTIS CSCL 8/5

Methods of joint reduction of gravimetric and satellite tracking data are discussed. They are destined to determine the coefficients C bar sub nk and S bar sub nk in the expansion of the earths potential in spherical functions. The coefficients C bar sub nk and S bar sub nk determined from satellite tracking data and the gravity anomalies according to Faye adjusted in a constant radius, are taken as measured values. To eliminate the influence of high-order harmonics it is recommended to use very smoothed anomalies and while solving the equations of errors to compute the anomaly differences, corresponding to gravimetric and satellite data, from the differences of the coefficients in their spherical function expansion. It is suggested to use the obtained data for determining the weights both of the gravity anomalies and of the harmonic coefficients obtained from satellite tracking data. Author (GRA)

N71-24393# Radio Corp. of America, Princeton, N.J.
CORRELATION OF SEA SURFACE ROUGHNESS WITH MICROWAVE RADIOMETRIC TEMPERATURE
Dori G. Shipley and Melvin N. Miller Mar. 1971 21 p refs
(Contract N00014-71-C-0013)
(AD-719447; AED-R-3686) Avail: NTIS CSCL 8/10

A series of microwave measurements of the vertically polarized radiometric brightness temperature of the sea surface was analyzed for correlation to observed sea surface roughness. The ratio of the measured brightness temperature to the calculated specular temperature was used as a roughness parameter. This roughness parameter, when least squares fit to a linear equation having the swell height and wind chop height as independent variables, showed a predominant dependency on chop height and a negligible dependency on swell height. The maximum sensitivity of the roughness parameter was noted to occur at incident observation angles of 78 to 79 degrees, which occurs close to the Brewster angle of 82.5 degrees. The dependency of the roughness parameter on the chop height was minimized in the observation angle range of 60 to 64 degrees, which compares well with theoretical predictions of a sea surface roughness invariant angle by other investigators. Author (GRA)

N71-24400# Istituto di Fisica dell Atmosfera, Rome (Italy).
A NUMERICAL MODEL OF THE ADRIATIC SEA FOR THE STUDY AND PREDICTION OF SEA TIDES AT VENICE
C. Finizio, S. Palmieri, and A. Riccucci Apr. 1970 92 p refs Sponsored by Min. Lavori Pubblici Prepared jointly with Servizio Meteorol. dell'Aeron.
(IFA-STR-12) Avail: NTIS

The application of a physical mathematical model of the Adriatic Sea to the problem of predicting the sea level variations at Venice is described. Motion equations are determined, including the wind stress and the bottom friction. Taking into account the peculiar topography of the region, a one-dimensional model of the Adriatic Sea is formulated. The problem of the integration of the basic equation is considered, conditions for the computation stability are determined, and a first test of the model is carried out by computing the variation in time of some fundamental quantities like the mass and energy of the basin. Author (ESRO)

N71-24406# Institut d'Aeronomie Spatiale de Belgique, Brussels.
UPPER ATMOSPHERIC DENSITIES BETWEEN 155 AND 165 km BY OBSERVATION OF AIO CLOUDS
M. Ackerman and P. Simon 1971 11 p refs Submitted for publication *Its* Aeronomica Acta No. A-83-1971
Avail: NTIS

Thermospheric densities have been deduced from diffusion coefficients measured on AIO clouds released by ESRO rockets. The results are compared with previous data and the role of vertical motions of artificial clouds in the interpretation is emphasized. Author (ESRO)

N71-24415# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
GEOPHYSICS AND SPACE DATA BULLETIN, VOLUME 3, NO. 3, THIRD QUARTER 1970
Anne L. Carrigan Sep. 1970 341 p
(AD-718107; AFCRL-70-0685; AFCRL-SR-111) Avail: NTIS CSCL 8/2

The document is a quarterly publication that contains AFCRL contract and inhouse data reported from sites throughout the world. Program descriptions for all data sections are updated annually or as required, and are presented in Number 1 of each volume. The following types of data are contained within each issue: magnetometer, cosmic ray, ELF noise, riometer, solar optical and radio emission, and ionosonde. This issue covers such data for July, August, and September 1970. Author (GRA)

N71-24425# Aerospace Corp., El Segundo, Calif. Lab. Operations.
INFLUENCE OF GRAVITY WAVES ON TRANSIENT HEATING RESPONSE OF THE UPPER ATMOSPHERE

Technical Report, Aug. 1969 – Feb. 1970
Yam T. Chiu and Barbara K. Ching 15 Dec. 1970 53 p refs
(Contract F04701-70-C-0059)
(AD-718961; TR-0059(6260-10)-3; SAMSO-TR-71-21) Avail: NTIS CSCL 4/1

It is shown that the presence of gravity wave interaction with a transiently heated atmosphere changes the atmospheric response to heating significantly. The energy exchange between wave and ambient atmosphere manifests itself as an apparent increase in effective thermal diffusivity. The present model predicts altitude independent (<200 km) temperature and density time lags which are in phase and are (6 plus or minus 2) hours for a mean heating duration of (2-6) hours. It is shown that the above response characteristics are essentially independent of the spatial distribution and location of the primary heat source. This tendency is a consequence of the increased heat diffusion due to energy exchange between wave and ambient atmosphere. The energy loss to gravity waves during the falling phase of the response leads to the prediction of a relaxation time of (15 plus or minus 3) hours measured from the beginning of density decrease. The mean relaxation time for discernible major events in the Explorer 9 data is approximately 13 hours. Author (GRA)

N71-24584# Bonn Univ. (West Germany). Inst. fuer Astrophysik und Extraterrestrische Forschung.
RECENT OBSERVATIONAL RESULTS ON THE NEUTRAL UPPER ATMOSPHERE
M. Roemer Jun. 1970 31 p refs Presented at the 13th COSPAR Meeting, Leningrad, May 1970 *Its* Forschungsber. der Astron. Inst. Bonn No. 70-04
Avail: NTIS

A review is given of progress made in the investigation of the neutral upper atmospheric (thermosphere) density and composition, and their periodic variations, solar activity variations, and geomagnetic variations. ESRO

N71-24586# Bonn Univ. (West Germany). Inst. fuer Astrophysik und Extraterrestrische Forschung.
GEOMAGNETIC ACTIVITY EFFECT IN THE 250 TO 800 km ALTITUDE REGION
M. Roemer Jun. 1970 20 p refs Presented at the 13th COSPAR Meeting, Leningrad, May 1970 Sponsored in part by Bundesmin. fuer Bildung und Wiss. *Its* Forschungsber. der Astron. Inst. Bonn No. 70-03
Avail: NTIS

More than 200 gas density fluctuations following geomagnetic disturbances were used to deduce the reaction time of the upper atmosphere and the amplitude of the density variation. The altitude range from 250 to 800 km is covered by the data in the time interval from 1961 to 1966. ESRO

N71-24587# Bonn Univ. (West Germany). Inst. fuer Astrophysik und Extraterrestrische Forschung.
STRUCTURE OF THE THERMOSPHERE AND ITS VARIATIONS, DEDUCED FROM SATELLITE DECAY
Max Roemer Oct. 1970 98 p refs Presented at the Intern. School of Atmospheric Phys., Erice, Italy, 15 – 29 Jun. 1970 Sponsored in part by Bundesmin. fuer Bildung und Wiss. *Its* Forschungsber. der Astron. Inst. Bonn No. 70-11
Avail: NTIS

The observational results on the thermosphere and lower exosphere, i.e. the upper atmosphere in the 120 to about 1000 km altitude region, are presented. Orbital drag analysis has yielded most of the observational results on total gas density and in combination with atmospheric models also on temperature. Due to this fact the method of density determination from atmospheric drag is discussed in some detail. The important techniques for measuring atmospheric parameters in-situ are only briefly mentioned, but the results of in-situ measurements are incorporated in the presentation of thermospheric structure and its systematic variations. Author (ESRO)

N71-24588# Institut d'Aeronomie Spatiale de Belgique, Brussels.
DETERMINATION OF THE EARTH'S THERMOSPHERE DENSITY DEDUCED FROM THE OBSERVATION OF THE ARTIFICIAL CLOUD ALUMINUM OXIDE FLUORESCENCE [DETERMINATION DE LA DENSITE DE LA THERMOSPHERE TERRESTRE PAR L'OBSERVATION DE LA FLUORESCENCE DE NUAGES ARTIFICIELS D'OXYDE D'ALUMINIUM]
P. Simon 1971 25 p refs In FRENCH; ENGLISH summary Submitted for publication *Its* Aeronomica Acta No. A-81-1971
Avail: NTIS

The diffusion of AlO luminescent clouds formed during two rocket flights (ESRO payloads S 64-1 and S 64-2 on July 6 and 13, 1969, respectively) in Sardinia leads to the determination of the atmospheric density near 150 km in the terrestrial atmosphere. Author (ESRO)

N71-24591# Kiruna Geophysical Observatory (Sweden).
ON THE GENERATION AND DETECTION OF ARTIFICIAL ATMOSPHERIC WAVES
Ludwik Liszka and Sixten Olsson Feb. 1971 16 p refs Sponsored by the Swed. Natl. Council of Nat. Sci.
(KGO-711) Avail: NTIS

Preliminary results of detection of atmospheric waves produced by focusing of shocks generated by supersonic aircraft are presented. The flight trajectories were chosen so that the acoustic gravity waves following the shock front were focused on the ground after reflection from the stratosphere, or in the E-layer. Infrasoundic waves were detected on the ground using a 2 Hz infrasoundic interferometer-correlator. At the E-layer, the waves were detected using a modified vertical sounding technique. Results obtained during 11 test flights have shown that the ray tracing technique may be successfully used for predicting the propagation of atmospheric waves following shock fronts. Author (ESRO)

N71-24604# Texas Univ., Austin. Electronics Research Center.
ONE-DIMENSIONAL MAGNETOTELLURIC INVERSION TECHNIQUES
Charles E. Laird, Jr. and Francis X. Bostick, Jr. 1 Dec. 1970 106 p refs
(Contract N00014-67-A-0126-0004; Grant NSF GA-1236)
(AD-719392; TR-101) Avail: NTIS CSCL 8/7

The general nonlinear regression problem associated with the inversion of magnetotelluric data to a one-dimensional, horizontally homogeneous earth model is investigated. An automatic program that will invert most magnetotelluric data encountered by the author to a significant one-dimensional model without any interaction on the part of the computer operator is presented. A comparison is made of the Gauss-Newton method, a modified Newton-Raphson method, and the Nelder and Mead flexible simplex method for fitting data with a model in a least square sense. It is concluded that the modified Newton-Raphson method with a gradient starter is generally the most successful algorithm for inverting magnetotelluric data and also for use in the automatic program. Another study is made to determine what range of frequencies of the surface data are altered most by perturbations in the model at various depths. From this study and other work an algorithm is presented that generates a first guess model for a magnetotelluric inversion program. In addition, this perturbation technique is useful in determining what frequency range of data is necessary to define a particular geological profile. Many program

and model insensitivities that occur during the inversion process are categorized and discussed, and corrections for each type of insensitive program termination are suggested for use in the automatic program. Several examples of the automatic program inversions of theoretical data with and without noise and actual field data are presented and discussed. Author (GRA)

N71-24609*# Scientific Translation Service, Santa Barbara, Calif.
BALANCE OF RARE EARTH ELEMENTS IN GABBRO ROCKS OF THE KVIRANSK INTRUSION [BALANS REDKOZEMELNYKH ELEMENTOV V GABBROIDAKH KVIRANSKOY INTRUZII]
Yu. A. Balashov, et al Washington NASA Apr. 1971 17 p refs Transl. into ENGLISH from Geokhimiya (USSR), no. 10, 1970 p 1204–1214
(Contract NASw-2035)
(NASA-TT-F-13648) Avail: NTIS CSCL 08G

The distribution of rare-earth elements and yttrium in comagmatic series of rocks, formed during the course of fractional crystallization of a melt of basic composition, is determined by changes in the ratios of rock-forming minerals. The concentration of rare-earth elements (r.e.e.) in rock-forming minerals is the function of the values of r.e.e. distribution coefficients and of their activity in the melt at the moment of mineral crystallization. Author

N71-24610*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE COMPOSITION OF THE BASALTIC GAS PHASE
Bert E. Nordlie Washington May 1971 88 p refs
(NASA-TR-R-348; G-971) Avail: NTIS CSCL 08G

Volcanic gas collections are used to calculate the composition of the original magmatic gas. Alteration from this original gas, to varying degrees, by surface or near-surface modifying processes is hypothesized. Four methods of removing atmospheric contamination give, for each sample, four atomic compositions, which yield equilibrium (molecular) compositions from 650 to 1250 C at 1 atm. The compositions are used to examine other modifying processes. It is shown that water contamination causes all variations in hydrogen content. Sulfur content changes considerably from loss of SO2. Atmospheric and water contamination and SO2 loss are shown to account for all modifications. Although all samples were derived from an equilibrium composition at magmatic temperatures, examination shows that none is at equilibrium as collected. Imperfect quenching during, and oxidation during and after, collection caused nonequilibrium. The various contaminations and losses are discussed as they affect the total gas composition, quantitative amounts of additions, and losses being presented for each sample. Author

N71-24639# California Univ., La Jolla. Advanced Ocean Engineering Lab.
ADVANCED OCEANOGRAPHIC RESEARCH EQUIPMENT AND TECHNIQUES Annual Report, 15 Dec. 1969–31 Dec. 1970
William A. Nierenberg, Fred N. Spiess, Walter H. Munk, Robert D. Moore, and Hugh Bradner 31 Dec. 1970 141 p refs
(Contract N00014-69-A-0200-6012; ARPA Order 1348)
(AD-719420; AOEL-16; SIO-Ref-71-4) Avail: NTIS CSCL 8/3

The report reflects the technical status of projects conducted within the Advanced Ocean Engineering Laboratory at the Scripps Institution of Oceanography. These projects are: (1) Stable Floating Platform - to conceive, design, build and demonstrate the feasibility of large stable floating platforms in the open sea. (2) Benthic Array - a program to develop and construct a quartz vertical accelerometer appropriately packaged and adapted for long term ocean bottom use. (3) Overpressures Due to Earthquakes - a study of earthquakes and resultant overpressures as they may effect oceangoing vehicles and subsurface structures. (4) Advanced Studies in Nearshore Engineering - field studies of the water-sediment interface under wave action in and near the breaker zone; and laboratory investigation of the velocity field of breaking waves. (5) Electromagnetic Roughness of the Ocean Surface - concerns utilization of radio signals scattered from the sea surface to determine the directional spectrum of ocean waves. Author (GRA)

N71-24838# Naval Oceanographic Office, Washington, D.C.
WATER MASSES AND THE DISTRIBUTION OF OCEANOLOGICAL PROPERTIES [VODNYYE MASSY I RASPREDELENIYE OKEANOLOGICHESKIKH KHARAKTERISTIK]
Yu. A. Ivanov 1970 10 p refs Transl. into ENGLISH from Okeanologiya (USSR), v. 3, no. 5, 1963 p 803–807
(AD-718072; NOO-Trans-526) Avail: NTIS CSCL 8/3

By analyzing the distribution of oceanological properties or characteristics, one can see that the extreme values of individual characteristics, which are not associated with common origin, occur at various depths. It is, for example, known that in central parts of oceans the smallest concentrations of oxygen occur at smaller depths 500-1000M than the greatest concentrations of silicon acid. Still greater differences separate the extreme values of water temperature and salinity. Depth levels for maximum values of water temperature and salinity are given. On lat. 47 deg 30 min S the maximum temperature is observed at the depth of 1200m, whereas the maximum salinity is observed at the depth of 2000m, the difference being 800m on 55 degrees S the difference between the temperature and salinity values reaches 1600m, but on 68 degrees S 100m. North of 47 deg 30 min S the water temperature decreases gradually from surface to the bottom. The depth maximum of salinity is observed north of this latitude. Author (GRA)

N71-24989# Royal Greenwich Observatory, Herstmonceux (England). Time and Latitude Service.
GREENWICH TIME REPORT, APRIL–JUNE 1970
R. v. d. R. Woolley Jun. 1970 13 p
Avail: NTIS

Results of Greenwich time and latitude observations for the period April–June 1970 are presented. Also included are radio time signals and standard frequency emissions. Author (ESRO)

N71-24990# Royal Greenwich Observatory, Herstmonceux (England). Time and Latitude Service.
GREENWICH TIME REPORT, JANUARY–MARCH 1970
R. v. d. R. Woolley Mar. 1970 p 14
Avail: NTIS

Results of Greenwich time and latitude observations for the period January–March 1970 are presented. Also included are radio time signals and standard frequency emissions. Author (ESRO)

N71-25002# Kansas State Univ., Manhattan. Agricultural Experiment Station.
EVAPOTRANSPIRATION IN THE GREAT PLAINS SEMINAR
25 Mar. 1970 421 p refs Conf. held at Bushland, Tex., 23-25 Mar. 1970 *It*. Res. Comm. Great Plains Agr. Council Publ. No. 50
Avail: NTIS HC $8.00/MF $0.95

Papers are presented on regional research on evapotranspiration, and include uses, evapotranspiration models, and soils and plant effects. For individual titles, see N71-25003 through N71-15023.

N71-25003# Environmental Science Services Administration, Washington, D.C.
ESSA: A DISSEMINATOR AND USER OF ET DATA
G. L. Barger, T. L. Noffsinger, J. J. Rahn, and W. C. Palmer *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 1 6 (See N71-25002 13-13)

Avail: NTIS HC $6.00/MF $0.95

Data dissemination activities of Environmental Data Service and Weather Bureau are briefly reviewed, along with their network design and research program for evapotranspiration. J.A.M.

N71-25004# Texas A&M Univ., College Station.
USE OF EVAPOTRANSPIRATION RESEARCH BY THE AGRICULTURAL EXTENSION SERVICE
Leon Naw (Tex. Agr. Extension Service) and W. M. Lyle *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 7-11 (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

The small stepwise introduction of efficient water use and conservation to the farmers by the Agricultural Extension Service is examined and explained. The need for rapid improvements and for research on evapotranspiration is reported, along with its effects on planting and irrigation. J.A.M.

N71-25005# Department of Agriculture, Washington, D.C. Soil Conservation Service.
EVAPOTRANSPIRATION AND SOIL CONSERVATION SERVICE IRRIGATION OPERATIONS
Ralph H. Brownscombe *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 13-17 refs (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

The use of evapotranspiration data for determining the design capacity of farm and farm-group irrigation systems and for scheduling the time and amount of water to be applied in operation of these systems is summarized as a function of the Soil Conservation Service. The need for an estimating method for daily evapotranspiration rates is evaluated, based on available climatic data. J.A.M.

N71-25006# Interior Dept., Washington, D.C. Div. of Water and Land Operations.
RELATIONSHIP OF EVAPOTRANSPIRATION TO BUREAU OF RECLAMATION PROJECT PLANNING AND OPERATIONS
Maurice N. Langley and Charles Le Moyne, Jr. *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 23 Mar. 1970 p 19-27 refs (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

The Bureau of Reclamation's views and programs concerning evapotranspiration and water resource management are presented, emphasizing increased efficiency for irrigation and developing means for achieving more efficient use of water on the farm. J.A.M.

N71-25007# Forest Service, Denver, Colo.
THE USE OF EVAPOTRANSPIRATION INFORMATION IN THE FOREST SERVICE
James E. Reid *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 29-34 refs (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

The three major areas of the Forest Service: (1) management, protection, and development of the National forests and grasslands; (2) cooperation with State and private forest owners obtaining better forestry; and (3) needed research for forest and forested rangelands are covered, emphasizing their relationship to evapotranspiration. The major use of evapotranspiration data is reviewed for evaluation of management alternatives and their effects on wood, forage, water, recreation, and wildlife produced on the forests and grasslands. J.A.M.

N71-25008# Department of Agriculture, Washington, D.C. Economic Research Service.
USES OF EVAPOTRANSPIRATION DATA BY THE ECONOMIC RESEARCH SERVICE
William H. Heneberry *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 35-40 refs (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

Activities of the Economic Research Service related to evapotranspiration are outlined, including irrigation studies, weather information and modification studies, and comprehensive river basin planning. Evapotranspiration rates affecting water costs are briefly mentioned. J.A.M.

N71-25009# Texas Water Development Board, Austin.
USE OF EVAPOTRANSPIRATION INFORMATION BY STATE WATER RESOURCE AGENCIES
Paul T. Gillett *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 41-44 (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

The State governmental uses of evapotranspiration data for water resource planning and development and water resource use, operation, and management are summarized for both urban and nonurban conditions. Irrigated crop studies, hydrology refinement studies for nonirrigated grass and tree cover components of watersheds, and dryland cultivated crop studies are also examined. J.A.M.

N71-25010# Oklahoma State Univ., Stillwater. Dept. of Agronomy.
THE SYSTEMATIC APPROACH TO ET MODELING IN THE GREAT PLAINS
John F. Stone *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 45-54 refs *Its* J. Manuscript No. 2015 (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

Evapotranspiraton hydrological cycle modeling in the Great Plains is presented, emphasizing its potentials, complex systems, and research roles. Economic and sociological implications are considered, along with the possibility of widespread meteorological disturbances. The agricultural benefits of evapotranspiration modeling are determined as (1) water conservation for runoff and impoundment in liquid reserves, (2) understanding how to make plants thrive on less water, or understanding the characteristics needed for plants which could do this, and (3) enhancing agricultural production in the Great Plains region. J.A.M.

N71-25011# Texas A&M Univ., College Station.
AN EVAPOTRANSPIRATION MODEL FOR GREAT PLAINS GRASSLANDS
Wayne G. McCully and R. H. Haas *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 55-65 refs (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

Range classification and runoff and soil moisture measurements for an evapotranspiratoon model are evaluated. A water balance method was used to express evapotranspiration in a grassland model of the Great Plains. Precipitation was measured directly and accounted for by a specific time period. Factors affecting utilization of stored moisture by plants in a grassland community are also considered. J.A.M.

N71-25012# Agricultural Research Service, Kimberly, Idaho. Soil and Water Conservation Research Div.
IRRIGATION ORIENTED ET MODELS FOR THE GREAT PLAINS
Marvin E. Jensen and James L. Wright *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 67-78 refs (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

The requirements of irrigation-oriented evapotranspiration

models are given, as well as the major users of these models. Historical evapotranspiration data are developed from climatic data collected in previous seasons. Empirical functions are used for interaction data representing the combined effects of various climates, crops, and soils. The deficiencies in the present system for climatic data collection are also cited, as impeding evapotranspiration data acquisition. J.A.M.

N71-25013# Agricultural Research Service, Fort Collins, Colo.
EVAPOTRANSPIRATION MODEL FOR DRYLAND CROPS FOR THE GREAT PLAINS
Dale F. Heerman and H. R. Gardner *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 79–109 refs (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

A computer program was written for simulating dryland evapotranspiration. Thirty plots and lysimeters were simulated, using sorghum as the primary crop. In 1967 both dryland and irrigated plots were observed, including two plots and one lysimeter of oats. The percentage of error was minimized, because the estimated and measured evapotranspiration utilized nearly all available water. Author

N71-25014# Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
EVAPOTRANSPIRATION COMPONENTS OF WATERSHED MODELS FOR THE GREAT PLAINS
David A. Woolhiser, Roger E. Smith, and Clayton L. Hanson *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 111–136 refs (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

Mathematical models were used as the primary tool in studying watersheds and evapotranspiration processes. Evapotranspiration components in watershed models and sensitivity of surface runoff to initial soil moisture were also investigated. Digital computer simulation of soil moisture profile in Colby silt loam from rainfall of 3.0 and 3.1 in./hr is presented in graphic representations. J.A.M.

N71-25015*# Agricultural Research Service, Weslaco, Tex. Soil and Water Conservation Div.
REMOTE SENSING IN EVAPOTRANSPIRATION RESEARCH ON THE GREAT PLAINS
Craig L. Wiegand and Jon F. Bartholic *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 137–180 refs (See N71-25002 13-13)
(NASA-Order R-09-038-002)
(NASA-CR-118184) Avail: NTIS HC $6.00/MF $0.95 CSCL 08M

Remote sensing technology for evapotranspiration in the Great Plains is analyzed and is used for identification of main areas needing additional research: location and extent of vegetated and nonvegetated surfaces, surface temperature, net radiation, and distribution and amount of soil water. The capabilities of present and future aerospace vehicles are surveyed for instrumentation suitable for evapotranspiration remote sensing. A plant resistance model, a bare soil model, and a mixed plant-soil model are examined for the range in surface minus bulk air temperature expected as function of ambient vapor pressure, surface roughness, air temperature, and wind speed. It is concluded that remote sensors can be used with ground measurements to gather regional evapotranspiration data. Author

N71-25016# Agricultural Research Service, Bushland, Tex.
SOIL MODIFICATION FOR IMPROVING PLANT-WATER RELATIONS AND EFFECTS ON ET
F. H. Siddoway, Paul W. Unger, and Arland D. Schneider *In* Kans. State Univ. Envapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 181–205 refs *Its* J. Ser. No. 160 (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

Soil management inputs designed to increase bulk storage of water in the root-zone profile were applied between harvest and planting of the crop. Aside from weed control, irrigation is the primary water management tool that was used, with the exception of furrowing, residual mulching, and terracing. Stubble mulching was studied for erosion control during the fallow period. Profile modification effects on grain and stover yields and water use efficiency; soil bulk density, strength, and aggregate stability as affected by profile modification and sampling; and seasonal irrigation water intake on irrigation subplots receiving two seasonal irrigations are shown in tabular form. J.A.M.

N71-25017# South Dakota State Univ., Brookings. Dept. of Plant Science.
SOIL WATER EVAPORATION
Charles W. Wendt, Tamlin C. Olson, Howard J. Haas, and W. O. Willis *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 207–227 refs (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

Various methods and tests for suppression of soil water evaporation are outlined. Using organics to prevent soil water storage in the upper layers of the soil profile or creating large watersheds, store the water, and apply it to crops as needed through subirrigation systems are suggested. J.A.M.

N71-25018# Nebraska Univ., Lincoln. Dept. of Agronomy.
SPECIES, SOIL, CLIMATE, AND FERTILITY AS RELATED TO TOP GROWTH AND EVAPOTRANSPIRATION
Robert A. Olson, J. Kristian Aase, and Raymond E. Meyer (Tex. Technol. Coll) *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 229–253 refs (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

Dry matter production/water used = water use efficiency was the primary equation used to study top growth and evapotranspiration. Research on various aspects of evapotranspiration related to crop species, climate, and soil water and fertility affecting crop growth is reviewed. The relationships between dry matter yield and transpiration for barley, wheat, and oat varieties; cumulative evapotranspiration-cumulative yields relations for grain sorghum both in lysimeters and in surrounding plot; and photosynthesis vs. atmospheric carbon dioxide concentration at 18 mb vapor pressure deficit and at various light intensities and air temperature are given in graphic representations. J.A.M.

N71-25019# Montana State Univ., Bozeman.
EVAPOTRANSPIRATION AND ROOT GROWTH
Hayden Ferguson, Paul L. Brown, and D. W. Fryrear *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 255–274 refs *Its* J. Ser. No. 161 (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

The relationship between evapotranspiration and plant rooting properties for nonirrigated crops grown in the Great Plains is discussed. It was assumed that crop plants with an adequate extension and density of roots in the soil should be best able to cope with the harsh environment. The various types of plant roots are compared for water intake efficiency. J.A.M.

N71-25020# Nebraska Univ., Lincoln. Dept. of Horticulture and Forestry.
POTENTIAL FOR EVAPOTRANSPIRATION AND ITS MANIPULATION IN THE PLAINS REGION
Norman J. Rosenberg and William L. Powers (Kans. State Univ.) *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 275–299 refs Nebr. Agr. Expt. Sta. J. Ser.

No. 2808 (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

The potential evapotranspiration concept is analyzed. The concept states that evaporation from an extended surface of a short green crop which fully shades the ground, exerts little or negligible resistance to the flow of water, and is always supplied with water. Net radiation and advection measurements were used to calculate possible evaporation in arid and semi-arid regions. Manipulation methods of possible evapotranspiration are also considered, including plant canopy, windbreak, and reflectants. J.A.M.

N71-25021# South Dakota State Univ., Brooking.
ROLE OF PLANT CANOPIES IN EVAPOTRANSPIRATION
Maurice L. Horton, L. N. Namken, and Joe T. Ritchie *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 301-338 refs S. Dak. Agr. Exptl. Sta. J. No. 969 (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

Plant canopy effects on aerial environment are discussed, as well as canopy resistances to evaporation. Evaporation and water exchange with surroundings are outlined, emphasizing net radiation and soil evaporation below canopies, reflectance, and water stress. Management of plant canopies for efficient water use and canopy and aerial environment modification to improve energy and water use efficiency are also covered. J.A.M.

N71-25022# Agricultural Research Service, Manhattan, Kans. Soil and Water Conservation Research Div.
EVAPOTRANSPIRATION AND THE AERIAL ENVIRONMENT AS INFLUENCED BY WINDBREAKS
Edward L. Skidmore and L. J. Hagen *In* Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 339-368 refs Dept. of Agronomy Contrib. No. 1143 (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

Leeward air flow and the nature of incident wind are discussed, emphasizing wind speed, direction and duration, thermal stability, and terrain and surface roughness. Temperature, humidity, radiation, and carbon dioxide related to modification of the aerial environment are reviewed. Windbreak characteristics and influence of barrier induced microclimate on evaporation are also investigated. J.A.M.

N71-25023# Kansas State Univ., Manhattan.
PANEL DISCUSSION ON REGIONAL NEEDS FOR EVAPOTRANSPIRATION RESEARCH IN THE GREAT PLAINS
In its Envapotranspiration in the Great Plains Seminar 23 Mar. 1970 p 369-401 refs (See N71-25002 13-13)
Avail: NTIS HC $6.00/MF $0.95

A panel discussion is presented on evapotranspiration research in the Great Plains, concerning (1) adequate water balance data, (2) evapotranspiration reduction, (3) standardized measurements of evapotranspiration on plain-wide basis, and (4) a predictive evapotranspiration model. J.A.M.

N71-25062# Coast and Geodetic Survey, Rockville, Md.
SEISMIC ACTIVITY IN SEPTEMBER 1969 NEAR THE RULISON NUCLEAR TEST SITE
R. Navarro and S. R. Brockman 15 Jun. 1970 19 p refs Sponsored in part by AEC
(CGS-746-5) Avail: NTIS

Seismic activity in the vicinity of Project Rulison was monitored before and after the Sept. 10, 1969 detonation. No earthquakes were detected within 100 km of Rulison during the pre-event period of Sept. 3 to Sept. 10. The detection equipment and procedures, the calibration of the detection systems, and the methods used to calculate the magnitudes of shock waves from the detonation are discussed. Preliminary results indicate that the Rulison device behaved as expected, i.e., with a yield of about 40 Kt. The largest local post-shot shock had an approximate Richter magnitude of 2.3 and occurred on Sept. 13, 1969. NSA

N71-25064# Institut d'Aeronomie Spatiale de Belgique, Brussels.
MEASUREMENT OF UPPER ATMOSPHERIC WINDS AT 160 AND 275 KILOMETERS
M. Ackerman and E. Van Hemelrijck 1971 10 p refs Submitted for publication *Its* Aeronomica Acta No. A-82-1971
Avail: NTIS

Artificial A10 clouds formed by ESRO payloads S 64 at altitudes of 160 and 275 km have been tracked by optical methods to determine their motions during evening twilight. Important vertical motions have been observed at the low altitude. Horizontal winds have been measured at both altitudes. The high altitude data are compared with satellite data and with a model. Author (ESRO)

N71-25074# Alaska Univ., College. Geophysical Inst.
CRUSTAL DEFORMATION RELEASE, FAILURE AND TILTS IN ALASKA Final Report, Dec. 1969-Dec. 1970
Eduard Berg Jan. 1971 76 p refs
(Contract F44020-70-C-0031; ARPA Order 292)
(AD-719840; AFOSR-TR-71-0528) Avail: NTIS CSCL 8/7

The main purpose of the contract was to gain insight into the crustal failure mechanism and the associated source phenomenon in Alaska. This effort includes the operation of the short-period telemetry network and the three long-period borehole installations used for the measurements of crustal tilts. Through the telemetry system there is now on hand an almost complete record on the seismicity of Central Alaska, covering a total of four years, and of much higher accuracy than was hitherto available. The operation of the borehole long-period seismometer has revealed tilts associated with earthquakes as small as magnitude 3, which are consistent with the tectonic stress axis, but do not seem to conform to elastic fault dislocation models. Analysis of literature suggests that Russian observations of the Vp/Vs ratio, diminishing by about 0.1 prior to larger earthquakes, can be explained by the decrease in Vp/Vs ratio due to micro-fracturing (observed in the laboratory) and theoretical as well as experimental work on Vp/Vs changed as a function of porosity. Author (GRA)

N71-25078# Lockheed Missiles and Space Co., Sunnyvale, Calif.
DIURNAL OXYGEN VARIATIONS AT 65-200 km ALTITUDES
M. K. Ivelskaya et al 1971 5 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 10, no. 6, 1970 p 1048-1052
(AD-719843) Avail: NTIS CSCL 4/1

The continuity equations describing the altitude-time changes in concentration of atomic and molecular oxygen in the 65-200 km altitude range were solved. The results of the solution display a diurnal behavior with amplitude of about 1.5 -fold at 200 km, which agrees satisfactorily with experimental results for this altitude. Author (GRA)

N71-25082*# Lockheed Missiles and Space Co., Palo Alto, Calif. Space Sciences Lab.
LOCKHEED EXPERIMENT ON ATS-5 Quarterly Progress Report, 1 Dec. 1970 - 28 Feb. 1971
8 Mar. 1971 60 p refs
(Contract NAS5-10392)
(NASA-CR-118319; QPR-6) Avail: NTIS CSCL 03B

The experiment on ATS-5 continues to monitor the low energy particle environment at the synchronous altitude. The average properties of this environment are studied on a statistical basis, and systematic dependences on local time and magnetic activity are discussed. A study of coordinated ATS-5 and OV1-18 particle measurements has provided evidence for an auroral electron

acceleration mechanism operating between synchronous altitude and the ionosphere. Author

N71-25122# Japan Atomic Energy Research Inst., Tokai. Environmental Survey Section.

ENVIRONMENTAL MONITORING AT JAERI, TOKAI IN 1969

Oct. 1970 34 p refs

(JAERI-Memo-4175) Avail: AEC Depository Libraries

The environmental monitoring program at JAERI, Tokai consists of monitoring of the gamma exposure in the environment, measurement of the radioactivity in the environmental materials, and meteorological and oceanographic observations. Fallout nuclides produced by nuclear detonation tests were also investigated. The results of the monitoring are summarized except for the meteorologic and oceanographic observations. No abnormal radioactivity was found in the environment in association with the discharge of radioactive materials from the facilities of the Institute. The average concentrations in air of relatively short-lived radionuclides were two to three times as high as those in the preceding year, although the total amount of radioactivity in fallout remained on the same level. This suggests that new injections of nuclides into the atmosphere were brought about by the recent nuclear tests. Author (NSA)

N71-25123# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GLOBAL PHOTOGRAPHY OF THE EARTH AND POSSIBILITIES FOR INTERPRETING ITS DATA

B. V. Vinogradov et al 10 Nov. 1970 22 p refs Transl. into ENGLISH from the Russian

(AD-719781; FTD-HT-23-505-70) Avail: NTIS CSCL 8/2

The global photographs obtained from high-orbiting satellites Molniya, ATS, and spaceships Zond and Apollo represent super-small-scale space photographs or televised images of the Earth. Methods of using them for obtaining both global and area information on the natural complexes of the Earths surface - the geographical zones and topography - are discussed. Author (GRA)

N71-25147# Stanford Research Inst., Menlo Park, Calif.

SOURCES, ABUNDANCE, AND FATE OF GASEOUS ATMOSPHERIC POLLUTANTS Final Report

E. Robinson and R. C. Robbins Feb. 1968 128 p refs Prepared for Am. Petrol. Inst.

Avail: NTIS

The results are presented of a program aimed at a first effort in solving the problem of the integrated effects of natural and urban emanations in the atmosphere. Primary emphasis is placed on the atmospheric cycles of trace chemicals including but not being restricted to air pollutants. An examination is made of the present state of knowledge of atmospheric cycles and a variety of common gaseous materials. In addition, the major natural and urban pollution sources are analyzed, the effectiveness of applicable atmospheric reaction processes is estimated, and the effectiveness of the processes by which the material is finally removed from the atmosphere is determined. D.L.G.

N71-25148# Royal Aircraft Establishment, Farnsborough (England).

MEASURING TECHNIQUES FOR THE DETERMINATION OF THE CONCENTRATION AND MOBILITY OF ATMOSPHERIC IONS [MESSTECHNIK ZUR BESTIMMUNG VON KONZENTRATION UND BEWEGLICHKEIT ATMOSPHAERISCHER IONEN]

A. Hoegl May 1970 14 p refs Transl. into ENGLISH from Elektromedizin (W. Germany), v. 8, no. 3, 1963 p 148–152

(RAE-Lib-Trans-1435) Avail: NTIS

The measuring principles and the construction are described of Ebert ion counters for the determination of the concentration of small air ions. The sources of error in these devices are examined on the basis of recent investigations. A special measuring capacitor was developed for the determination of the mobility spectrum of air ions. The apparatus was first used to measure the range of mobilities ($k > 0.01$ sq cm/vel/sec) in naturally ionized air. The results showed that, in the small ion region, there was only one peak in the spectrum for positive ions and one for negative. Author

N71-25170# Space Disturbances Lab., Boulder, Colo.

HIGH ALTITUDE NUCLEAR DETECTION STUDIES. VOLUME 2: RESULTS AND RECOMMENDATIONS Final Report

A. G. Jean, C. E. Hornback, R. H. Doherty, L. D. Lewis and G. M. Lerfald Nov. 1970 141 p refs

(AD-719620; NOAA-TR-ERL-188-SDL-18-2-Vol-2) Avail: NTIS; SOD $1.25 CSCL 18/3

The results produced by the HANDS program are of three general types: developments in automatic processing and handling of geophysical data collected from a large number of sensors, and findings bearing on the capabilities of nuclear detection systems, and conclusions of rather broad scientific interest. Descriptions and/or examples of some of the more important of these results are given. An appraisal is made of the HANDS program, including some shortcomings, and some recommendations for future similar systems are given. Author (GRA)

N71-25172# Illinois Univ., Chicago. Dept. of Geological Sciences.

ENVIRONMENT PATTERN RECONSTRUCTION FROM SAMPLE DATA. 1: MISSISSIPPI DELTA REGION

Richard B. McCammon Feb. 1971 90 p refs

(Contract N00014-69-A-0090)

(AD-719946; TR-1) Avail: NTIS CSCL 8/8

A ten percent random sample of map data is judged adequate to reproduce the first order spatial characteristics of the distribution pattern for the seven major types of depositional environments in the Mississippi Delta region of Southeast Louisiana. This conclusion is based on: (1) dendrographs which portray interdistance relationships among mean coordinate locations for the different environments, (2) the sampling properties of the Goodmsn-Kruskal measure of cross association as it is applied to nearest unlike neighbor samples, and (3) proximal maps which are reconstructions of the original pattern based on sample data. In analyzing map patterns, principal component analysis can be used to depict spatial trends. Within the Mississippi Delta region, the natural levee, point bar, bay-sound, and beach environments show a marked linear trend whereas the swamp, lacustrine, and marsh environments are more isotropic. With respect to location, the lacustrine environment is situated in an intermediate position between nonmarine and marine depositional environments. Author (GRA)

N71-25186# Environmental Data Service, Silver Spring, Md.

TERRAIN AND CLIMATE

Robert W. Schloemer Apr. 1971 26 p refs

(NOAA-TM-EDS-19) Avail: NTIS

The effects of interaction between the atmosphere and terrain in producing climate are discussed in general terms. Large, intermediate, and small-scale interactions are considered separately. This basic meteorology of the major interactions, together with aspects of their effects on and application to civilization are presented. Finally, geophysical factors resulting in terrain changes and differences are examined. Author

N71-25204# University Coll., London (England). Dept. of Physics.

UPPER ATMOSPHERE NEUTRAL TEMPERATURE PROFILES IN THE AURORAL ZONE 1968 - 1970

David Rees Sep. 1970 20 p refs
(Contract F61052-68-C-0057)
(AD-719818; AFCRL-71-0084; SR-2) Avail: NTIS CSCL 4/1

Neutral temperatures have been measured above 120 km altitude from observations of the fluorescent emission of aluminium oxide and barium oxide clouds released from rockets launched at ESRANGE, Kiruna. The temperature observations showed a strong correlation with the C9 daily magnetic character rather than with the 3-hour Kp index. A small diurnal variation appeared from the data, the temperature at 165 km being on average 100K higher during evening twilight than morning twilight. No clear seasonal or longer term variations were apparent from the data. The results indicate a strong auroral zone enhancement of the heating associated with geomagnetic activity. Author (GRA)

N71-25243# Naval Oceanographic Office, Washington, D.C.
SEA ICE OF THE SOUTHERN OCEAN [MORSKIE LDY YUZHNOGO OKEANA]
L. I. Eskin 1971 14 p refs Transl. into ENGLISH from Probl. Arktiki i Antarktiki (Leningrad), v. 31, 1969 p 24–30
(AD-719987; NOO-TRANS-507) Avail: NTIS CSCL 8/12

In the Southern Ocean ice begins to melt by the end of November. In January the melting may reach 3-4cm a day. The melting ends in February and March, depending on the geographical location and climatological conditions. In the eastern hemisphere the ice edge disappears by the second half of February; in the western hemisphere it disappears later. The dates of the disappearance of ice for years 1956 and 1967 have been recorded at Mirnyy reyd, Molodezhnaya and Lazarev sectors. The formation of ice has been recorded for years 1956 to 1966 at Mirnyy reyd. In addition, the paper lists data on drift ice and ice boundaries, their variations, ice thickness, melting, formation, concentration and other aspects. Author (GRA)

N71-25264*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STRONGLY DAMPED GRAVITY WAVES IN THE EARTH'S ATMOSPHERE
Igor J. Eberstein *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 38–40 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 03B

A series of vertical atmospheric soundings between 30 km and 120 km are computed and a wave like structure is observed in mean atmospheric deviations. This wave grows slowly below 80 km and then more rapidly. Calculations of gravity wave propagation show that experimental results approach closely a plain, upward propagating, strongly damped gravity wave structure and that its most important damping mechanism is turbulence. G.G.

N71-25267*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LATITUDINAL DISPERSION OF GASES IN THE UPPER ATMOSPHERE
Carl A. Reber *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 49–52 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 04A

Mass spectrometer data from OGO-F satellite trajectory through the symmetrical atmosphere establish a separation of the densities of the major gases from the He density, with the He peak occurring later in the orbit. The perigree was between the N2 and the O peaks, and the difference in latitude between the peaks of the major gases and the He was about 50 degrees. G.G.

N71-25268*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AIRGLOW OBSERVATIONS FROM OGO 4
Edith I. Reed *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 53–57 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 04A

OGO 4 photometric airglow measurements on the 6300 A red line of atomic oxygen below 40 degrees of latitude are related to neutral and charged components in the atmosphere. This arc of the red airglow with intensities of up to more than 1,000 rayleighs is closely related to the ionospheric equatorial anomaly of the daytime F-region. Absence of the southern arc over much of the Pacific is attributed to energy loss through molecular collisions or insufficient charge exchange reactions. G.G.

N71-25269*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ARTIFICIAL AURORA EXPERIMENT
John C. Price *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 58–62 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 04A

A rocket flown electron accelerator was used to fire a programmed sequence of pulses downward along the magnetic field line in an effort to generate a visible auroral spot when the electron beam hits the earth's atmosphere. Failure of the auroral simulation experiment was attributed to a strong electric field that scattered the beam so that it did not follow the field line down to the earth atmosphere. G.G.

N71-25270*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THERMAL PLASMA NEAR THE PLASMAPAUSE
Joseph M. Grebowsky *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 63–65 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 04A

A schematic model of the mechanism responsible for the formation of the plasmapause near the equatorial plane is formulated. The rapid drop of electron density with increasing altitude is associated with troughs in the latitudinal distribution of light ions and electrons as well as with a change in the plasma's state of motion along the magnetic field lines. Also incorporated into this model are plasma fluxes which continually move upward as an ionospherically produced plasma replenishes the plasma loss. Comparison of model computations with OGO-D measurements on a H+ ion trough at 900 km showed good agreement. G.G.

N71-25271*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE INFLATION OF THE INNER MAGNETOSPHERE
Masahisa Sugiura *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 66–68 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 04A

OGO-B and OGO-E magnetic field measurements are used to map magnetospheric field magnitudes and disturbances in the geomagnetic noon-to-midnight meridian plane for a slightly disturbed condition. Established is the existence of a large positive field region at middle to high latitudes and the large decrease of the field in the inner magnetosphere. These phenomena are attributed to an inflation of the inner magnetosphere by a ring of particles; intensities of the quiet time ring currents are greater by a factor of 2 or 3 than generally supposed and vary considerably, even during slight disturbances. G.G.

N71-25272*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AURORAL PARTICLE INJECTION AND DRIFT
Robert A. Hoffman *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 69–72 (See

N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 04A

The source location of electrons that cause the aurora in the auroral oval is attributed to bombardment of the upper atmosphere by electrons with energies from about 1 to 10 kV. Measurements by satellite borne detectors in low altitude polar orbits show that electrons precipitate not only at midnight but in a region extending from a few hours before midnight through the morning hours to local noon. These electrons are injected onto magnetic field lines emanating from the earth during substorms and subsequently drift on closed field lines through the morning hours to local noon where they are measured later precipitating into the atmosphere. G.G.

N71-25273*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OGO 5 MEASUREMENTS OF ELECTRONS NEAR THE MAGNETOPAUSE
Keith W. Oglivie *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 73-75 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 04A

Observations of low energy electrons by OGO-E differential electrostatic spectrometer show a sharp increase in 45 eV flux time coincident with the magnetopause crossing. Flux curve evaluations indicate that the magnetopause does not always move and that if it is stationary, a thickness at the unstable region of about 100 km is the correct order of magnitude. G.G.

N71-25282*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE HEATING OF THE CHROMOSPHERE
Stuart Jordan *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 111-113 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 04A

Collisional processes are considered in determining population densities and kinetic temperature distribution in the solar atmosphere. Equations for statistical equilibrium in the single-bound level of the negative hydrogen ion and for energy conservation are formed and used to make rough estimates of the upper limit on the amount of mechanical energy required to balance the net radiative losses of chromospheric heating between limiting values characterizing the very high and the very low density regions. G.G.

N71-25383# Space Disturbances Lab., Boulder, Colo.
HIGH ALTITUDE NUCLEAR DETECTION STUDIES. VOLUME 1: THE HANDS SYSTEM
C. E. Hornback Nov. 1970 92 p refs
(AD-719619; NOAA-TR-ERL-188-SDL-18-Vol-1) Avail: NTIS; SOD $1.00 CSCL 18/3

The report presents a summary of the engineering aspects of the High Altitude Nuclear Detection Studies (HANDS) project. The system was oriented around a computer that performed control functions and recorded and processed data from a number of geophysical sensors. Brief descriptions of the facility and various sensor equipment are presented. The system operation is described, and some recommendations are given. Author (GRA)

N71-25386# Naval Oceanographic Office, Washington, D.C.
SD CURRENT DIRECTION CHANGES IN THE VICINITY OF GEOMAGNETIC POLES [IZMENCHIVOST V NAPRAVLENII SD-TOKOV V RAYONE GEOMAGNITNYKH POLYUSOV]
B. G. Belousov et al 1971 8 p refs Transl. into ENGLISH from Problemy Arktiki i Antarktiki (Leningrad), v. 31, 1969 p 90-92
(AD-719989; NOO-Trans-509) Avail: NTIS CSCL 8/14

As is known, westerly electric current loops occur in winter in the polar cap region. Changes in the magnetic field in the region are indicative of the phenomenon. It appeared that currents in a circle 80 degrees wide were running as a rule from the 22 hour meridian to the 10 hour meridian. However, this main direction can change with time. It can be assumed that the indicated temporary changes can be utilized as an important property of interaction between the earths magnetic field and corpuscular radiation of the sun. As a result, they constituted an independent object of investigation. The data of Arctic and Antarctic stations lying above lat. 75 degrees and collected during 1957-1964 show cyclic and seasonal changes in the direction of currents, as well as the relation between the direction of SD currents, the velocity of solar wind and intensity of neutron components of cosmic rays. The close statistical link that was established during the study suggests that the observed phenomena have common causes. Author (GRA)

N71-25401# Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.
GLOBAL RADIATIVE HEATING OF THE EARTH'S ATMOSPHERE
Thomas Gilbert Dopplick 15 Apr. 1970 36 p refs
(Contract AT(30-1)-2241)
(MIT-2241-58) Avail: NTIS

Monthly zonal mean global radiative heating rates were obtained from the surface to 10 mb for all twelve months. Seasonal profiles of the contribution by each constituent are presented in addition to seasonal profiles of net thermal cooling and total radiative heating. Radiation cools the troposphere almost everywhere primarily due to water vapor and the radiative cooling is maximum in the tropics. The tropical stratosphere is heated by radiation due principally to thermal and solar heating by ozone. This radiative heating extends into the stratospheric mid-latitudes but higher latitudes exhibit cooling due primarily to thermal cooling by carbon dioxide with the warmer hemisphere showing more cooling. Comparison with previous theory in the Northern Hemisphere shows qualitative agreement although the present study has more resolution because of the better specification of the radiative parameters, in particular, ozone and temperature. Comparison of the energy available to the earth-atmosphere system between theory and satellite measurements shows that theory overestimates the amount of energy available which is probably due to the use of mean optical properties of clouds and the ground. Author

N71-25418# National Oceanic and Atmospheric Administration, Rockville, Md.
ALEUTIAN SEISMIC PROGRAM, SEISMOLOGICAL BULLETIN, OCTOBER 1970
Jan. 1971 76 p
(Contract AT-(29-2)-746)
(CGS-746-112) Avail: NTIS

Data acquired from an Aleutian network of seismic stations in order to facilitate current studies of earthquake occurrence in the Aleutian Islands is reported. Record arrival times and amplitudes are scaled. Final reduction and collation of data to event hypocenters and derivation of related parameters are performed. This compilation is preliminary and may be subject to later revision on the basis of current research. Author

N71-25419 Department of Energy, Mines and Resources, Ottawa (Ontario). Earth Physics Branch.
THE STRONG MOTION SEISMOGRAPH NETWORK IN WESTERN CANADA, 1970. VOLUME 41, NO. 2
G. C. Rogers, W. G. Milne, and M. N. Bone 1970 18 p refs
Copyright. Avail: Issuing Activity

The aim of the strong motion program on the west coast of Canada is to obtain basic ground motion data on varied

geological and soil formations during large earthquakes. In an effort to restrict measurements to that of true ground motion (and not building motion), the instruments were placed in the basement of buildings. The buildings are low and have a relatively small mass to minimize the influence of the building on the true ground motion. Instruments are distributed along the coast from Prince Rupert to Victoria. Author

N71-25452# Coast Guard, Washington, D.C.
TECHNIQUE FOR OBTAINING SEA ICE THICKNESS MEASUREMENTS FROM AIRCRAFT
J. A. McIntosh and C. Wayne Young [1970] 8 p refs Presented at the Offshore Technol. Conf., Houston, Tex. Sponsored by AEC Prepared in cooperation with Sandia Corp., Albuquerque, N.Mex.
(SC-DC-71-3664; CONF-710303-1) Avail: NTIS

The feasibility of measuring ice thickness with instrumented projectiles is examined. A number of projectiles of different weights and diameters were dropped at various impact velocities to determine their effect on ice penetration. Ground truth measurements at each penetration site included thickness, temperature, salinity profiles, and a tensile strength test on selected cores. In addition, an attempt was made to determine if any ice spalled at the ice water boundary. The tests were conducted at Port Clarence, Alaska. E.H.W.

N71-25480# Sandia Corp., Albuquerque, N.Mex.
ENVIRONMENTAL ENGINEERING ABSTRACTS
Oct. 1970 10 p refs Sponsored by AEC
(SC-R-70-4211) Avail: NTIS

Thirty-two abstracts on environmental engineering subjects are presented. Bibliographical data are included with the abstracts, which are arranged for rapid machine retrieval. E.C.

N71-25496*# Texas A&M Univ., College Station. Remote Sensing Center.
RADAR STUDIES OF ARCTIC ICE
J. W. Rouse, Jr. and J. A. Schell Oct. 1970 62 p refs
(Grant NsG-239-62)
(NASA-CR-118340; RSC-20) Avail: NTIS CSCL 08L

Analysis of 2.25 cm wavelength radar measurements of Arctic ice has shown that identification of several different ice types is possible. The identification accomplished in the analysis depends almost entirely upon radar return effects due to surface topography. In laboratory tests using simulated radar data which contained effects due to topography only, it was found that near real-time identification of some ice types could be accomplished using a relatively simple electronic network. The results of the analysis are summarized and the system simulation is described. A qualitative model for sea ice backscatter is proposed which emphasizes surface topography and near-surface volumetric scattering as the dominant factors effecting the radar return. The model, which incorporates recent experimental results of depolarization dependence, suggests a new approach to interpretation of radar backscatter from sea ice. Author

N71-25527# Boeing Scientific Research Labs., Seattle, Wash. Environmental Sciences Lab.
TABULATION OF RAPID-RUN GEOMAGNETIC MICROPULSATION STATIONS
H. B. Liemohn Jan. 1971 42 p refs Prepared for Intern. Assoc. of Geomagnetism and Aeronomy Comm. 4, Working Group 5
(DI-82-1043) Avail: NTIS

Ground-station tabulations are presented alphabetically by observatory-location name and numerically by geomagnetic latitude and longitude. The following information is contained: (1) name of local community where geomagnetic station is located, (2) person or institution responsible for data handling and exchange, (3) country in which station is located, and (4) country that sponsors the operation of the station. The purpose of the tables is to facilitate cooperative research programs on geomagnetic micropulsations between groups of ground observers and ground-satellite observers. The data was compiled from questionaires, correspondence, open literature, and earlier tabulations. In addition, a list of spacecraft magnetometer experiments is included. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N71-24373# Royal Aircraft Establishment, Farnborough (England).
THE EFFECT OF HUMIDITY ON A CORONA DISCHARGE IN AIR
B. R. Maskell Jun. 1970 27 p refs
(RAE-TR-70106) Copyright. Avail: NTIS

The effect of humidity on a corona discharge in air is investigated and found to produce a decrease in discharge current of about 20% for a change in humidity from dry to saturated conditions at atmospheric pressure and room temperature. It is suggested that this effect can be used to measure humidity in applications where rapid response is essential and the need to compensate for moderate temperature and pressure changes can be tolerated. Author (ESRO)

N71-24374# Ballistic Research Labs., Aberdeen Proving Ground, Md.
MEASUREMENTS OF THE DYNAMICAL BEHAVIOR OF PROJECTILES OVER LONG FLIGHT PATHS
William H. Mermagen Nov. 1970 50 p refs
(AD-717002; BRL-MR-2079) Avail: NTIS CSCL 19/4

The yawing and rolling behavior of projectiles is studied using solar aspect sensors to provide one-dimensional data in the form of solar aspect angle as a function of time of flight. The instrumentation is described and data handling procedures to extract two-dimensional motion from the data are discussed. Several interesting flights of fin and spin-stabilized shell are described in detail. Large amplitude yawing motion and roll reversal with the possibility of resonance have been observed on instrumented flights. The pitch frequencies are well determined and the derived modal amplitudes and phases seem reasonable. Applications and limitations of the technique are discussed. Author (GRA)

N71-24403# Compagnie des Compteurs, Montrouge (France).
STUDIES FOR THE REALIZATION OF AN AIR BEARING ANGULAR ATTITUDE MEASURING SYSTEM
Sep. 1970 135 p
(Contract ESTEC-733/HP)
Avail: NTIS

A proposal is given for an air bearing angular attitude measuring system. In particular, attention is paid to the analysis of different angular errors, the self-collimating guidance sensor, and the servo system. ESRO

N71-24404# Junta de Energia Nuclear, Madrid (Spain). Direccion de Quimica e Isotopos.
RADIOISOTOPIC TECHNIQUES APPLIED TO A VAPORIZING LIQUID FUEL GAUGE FOR USE IN SPACECRAFT Final Report
I. Esparragues, N. Ortin, and M. del Val Mar. 1971 63 p refs
(Contract ESTEC-584/68-SL)
(IS-2215/I-1) Avail: NTIS

A survey is given of radioisotope fuel gages for use with spacecraft liquid propellants, such as ammonia or propane. Of all methods considered, the gamma source gage using Kr-85 is recommended. ESRO

N71-24405# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France). Dept. d'Etudes et de Recherches en Technologie Spatiale.

DESCRIPTION AND PERFORMANCE OF IONIC PULVERIZATION DEVICE [DESCRIPTION ET PERFORMANCE D'UN DISPOSITIF DE PULVERISATION IONIQUE]

J. Bernard, J. P. Buisson, R. Masic (Thomson-Csf, Corbeville, France), and A. Richardt (VEECO, Versailles, France) Feb. 1971 11 p refs In FRENCH

(ONERA-DERTS-NT-02-22) Avail: NTIS

An ion source of duoplasmatron-type is described and its performance characteristics listed. ESRO

N71-24419# European Space Research Inst., Frascati (Italy).

LARGE-APERTURE FABRY-PEROT AIRGLOW SPECTROPHOTOMETER WITH INTERNAL LASER REFERENCE

G. Benedetti-Michelangeli, G. Cappuccio, F. Congeduti, and G. Fiocco 1971 10 p refs Submitted for publication

Avail: NTIS

The design of a Fabry-Perot spectrophotometer is described which is used in the observation of airglow. A high stabilization is achieved by using the output from a helium-neon laser to calibrate the instrument at regular intervals. ESRO

N71-24420# Signals Research and Development Establishment, Christchurch (England).

A VARIABLE TEMPERATURE DEWAR FOR THE RANGE 77 K TO 400 K

J. M. Williams and R. J. Woodward Oct. 1970 15 p refs

(SRDE-70048) Avail: NTIS

A variable temperature dewar operating in the range from 77 to 400 K is described. Temperature control is better than 0.1 K with rapid temperature changes possible. An additional facility for programming the dewar to give a linear variation of temperature with time is described, together with full constructional details. Author (ESRO)

N71-24422# National Physical Lab., Teddington (England). Div. of Quantum Metrology.

NPL CURRENT BALANCE 1969–1970

P. Vigoureux and N. Dupuy Dec. 1970 14 p refs

(NPL-QU-16) Copyright. Avail: NTIS

The NPL Ayrton-Jones current balance was modified in 1968/69 and was used in the winter of 1969/70 to compare with the ampere the unit of current (A sub NPL) maintained at the NPL by resistance standards and Weston cells. The modifications brought some improvement to the performance, but more extensive changes are desirable. The results indicate, subject to some reservations, that the NPL ampere has increased by 1.9 + or -0.8 (50% probability) in 1,000,000 between 1962/63 and 1969/70. Author (ESRO)

N71-24424# Army Foreign Science and Technology Center, Charlottesville, Va.

INVESTIGATION OF ULTRASHORT LIGHT PULSES BY ELECTRONIC OPTICAL CONVERTOR WITH TIME SCAN [ISSLEDOVANIE ULTRAKOROTKIKH IMPULSOV SVETA PRI POMOSHCHI ELEKTRONNO OPTICHESKOGO PREOBRAZOVATELYA S VREMENNOI RAZVERTKOI]

N. G. Basov et al 10 Nov. 1970 11 p refs Transl. into ENGLISH from the Russian Report

(AD-719481; FSTC-HT-23-522-70) Avail: NTIS CSCL 14/3

The report describes the type FER-2 photoelectronic recorder with electronic-optical convertor and the results of investigation of the time parameters of semiconductor lasers, produced, using the recorder. The effect of the recorder is based on the usage of the method of electronic-optical chronography. The FER-2 allows the time relationships of light pulses of one-time processes to be determined with an accuracy to 2 x 10 to the minus 11th power sec. Author (GRA)

N71-24479# Army Aviation Systems Test Activity, Edwards AFB, Calif.

EVALUATION OF FUEL FLOWMETER INSTRUMENTATION Final Report, 5 Aug.–20 Oct. 1970

Albert L. Winn and Robert P. Jefferis Jan. 1971 30 p refs

(AD-719280; USAAST-70-33) Avail: NTIS CSCL 14/2

Flight tests on the Flow Technology Inc. standard line turbine flow transducer were conducted between 5 August and 20 October 1970 to determine its acceptability as a test instrument. The evaluation was conducted at Edwards Air Force Base, California, by the US Army Aviation Systems Test Activity. Ground calibrations showed that the sensor can be used with precision equal to present flow measurement methods. The testing consisted of 2.9 flight hours with the measurement systems mounted in a UH-1C helicopter. The Flow Technology sensor performance was compared to that obtained with standard Potter and Revere flight test systems. Results show that the sensor is acceptable as a flight test instrument. The indicator sensitivity is excellent and there was no degradation of meter performance with variations in engine power or flight conditions. Although the indicator scale range was suitable for this test, the range is not large enough to be operable on all Army aircraft. Author (GRA)

N71-24514*# Los Alamos Scientific Lab., N.Mex.

DEVELOPMENT AND FEASIBILITY TESTS OF ISOTHERMAL IRRADIATORS

C. V. Weaver, A. J. Patrick, and W. A. Ranken *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 184–196 refs Sponsored by AEC (See N71-24501 13-22)

Avail: NTIS HC$9.00/MF$0.95 CSCL 18D

Laboratory and reactor tests are described which are used to show that specimen temperatures in irradiation experiments can be established and regulated through the use of inert-gas-filled heat pipes. When properly constructed, such pipes will last almost indefinitely and require no servicing. With the wide choice of available working fluids, there is no real restriction on the operating temperature of such devices other than the temperature of the reactor coolant. Author (NSA)

N71-24519*# Argonne National Lab., Ill. Reactor Engineering Div.

DEVELOPMENT OF FISSION GAS PRESSURE TRANSDUCERS AT ARGONNE NATIONAL LABORATORY

J. R. Folkrod *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 267–280 ref (See N71-24501 13-22)

Avail: NTIS HC$9.00/MF$0.95 CSCL 18D

Development of fission gas pressure transducers of the null-balance and fluid-filled bellows-capillary types is described. The null-balance type, which most people are familiar with, works on the principle of a moving diaphragm which makes contact with a probe. Contact with the probe closes an electrical circuit and allows a gas solenoid valve to open. The gas, known as the reference gas, pressurizes the system and causes the diaphragm to break probe-diaphragm contact to close the valve. The pressure of the reference gas is then equivalent to the fission gas pressure. Further operation of the valve will not take place until the fission gas increases in pressure. The fluid-filled bellows-capillary transducer

system may not be too familiar. It is, however, analogous to the large diaphragm-capillary fluid-filled systems built by Taylor and other well known like companies. The only difference is that the large diaphragm is replaced by a bellows. Author (NSA)

N71-24522*# Gulf General Atomic, San Diego, Calif.
HIGH TEMPERATURE THERMAL CYCLING AND DRIFT TEST OF W95Re5 VERSUS W74Re26 THERMOCOUPLES
D. E. Schwarzer *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 307-329 (See N71-24501 13-22)
(Contract NAS3-6471)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18D

Tests of thermocouples using W95Re5 versus W74 Re26 sensor wires for monitoring in-pile fuel temperatures are presented. A tantalum swaged hot junction with various multi-sensor wire configurations is described as are the test results. Thermocouple calibrations were accomplished prior to thermal cycling from 1800 C to <500 C, after thermal cycling and after a 500 hour life test at 1650 C. Test results indicated that the thermal emf of the tested thermocouples were in agreement with the published millivolt output data and that stable output was maintained after many thermal cycles and for long periods of time at high temperature. The test apparatus is described as are the post-test examination results of the thermocouples, showing the impurities in two different samples of beryllia used in testing. Metallographic examination of the swaged tantalum plug and sensor wires showed no contamination and also that a good contact was maintained between adjacent thermocouple wires. Two short term tests of 155 and 100 hours at 1650 C using W97Re3 versus W75Re25 as the sensor wires are briefly discussed. These sensor wires were in the same four wire, four slot configuration as those used for the 500 hour life test. The test results also agreed with published data and were stable over the lifetime of the test. No failure occurred during any of the testing. Author (NSA)

N71-24523*# Los Alamos Scientific Lab., N.Mex.
GROOVED MELT WIRES FOR TEMPERATURE MEASUREMENT OF REACTOR FUEL
P. G. Salgado, B. J. Thamer, and R. L. Rudman *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 330-349 refs Sponsored by AEC (See N71-24501 13-22)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18D

As a means for measuring temperatures in UHTREX, certain fuel elements have been examined after test to see which of an implanted array of melt wires have melted. Grooved melt wires have been developed covering the temperature range of 275 to 3000 F. Melting can be determined easily and with good precision by radiographing the exposed fuel element or by removing the melt wires for a visual examination. Author (NSA)

N71-24525*# Los Alamos Scientific Lab., N.Mex.
RECENT ADVANCES IN FAST RESPONSE MINIATURE NEUTRON FLUX MONITORS
D. B. Stillman and R. L. Chaney *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 366-377 refs (See N71-24501 13-22)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18D

A fast response miniature neutron detector has been developed to measure temperature-time history of fissile materials under intense neutron irradiation. The fissile-sensing element of the fission couple neutron detector is approximately 0.030 in. in diameter. The detector sensitivity for thermal neutrons is approximately 10 to the 9th power n/sq cm/deg C. To determine any limitations in response time, fission couples were placed 3 m from a nuclear device in an underground nuclear weapons test. The detector accurately followed the change in neutron population (alpha measurement) as the device exploded. A number of experiments were performed in various reactors so that such a detector could be developed. The significance of the results obtained with fission couples suggests numerous applications in neutron diagnostics and reactor controls. The most obvious application for this instrument would be mapping of the neutron flux in and around a reactor. The miniature size and fast response of a fission couple combine to offer unique advantages as a new tool in reactor diagnostics and control. Author (NSA)

N71-24539*# Gulf General Atomic, San Diego, Calif.
RELIABILITY OF HIGH TEMPERATURE THERMOCOUPLES IN IRRADIATION CAPSULES
N. L. Sandefur, F. D. Carpenter, R. J. Grenda, and J. S. Steibel *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 551-582 (See N71-24501 13-22)
(Contract AT(04-3)-167)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18D

Instrumented (lead-tube type) capsules, which contained a total of 200 Chromel-Alumel and tungsten-rhenium sheath-type thermocouples, were investigated. Testing conditions ranged from low neutron exposures to a total fluence of 4.5 × 10 to the 21st power n/sq cm (E > 0.18 MeV) with operating temperatures to 1800 C. Thermocouple performance was evaluated as a function of the following: neutron exposure; operating temperature; time at temperature; thermocouple type; type of hot junction; manufacturer; commercial construction versus construction to specification; and position of thermocouple within the capsule. Correlations were deduced concerning the in-pile behavior of the thermocouples and the probability of their successful operation. Postirradiation continuity and metallographic analyses were conducted on selected thermocouples to help establish location and/or causes of failure. The computer analyses revealed that a 30% to 40% thermocouple failure rate can be expected under any set of conditions examined. The probability of failure was greater with increasing neutron exposure and longer times in the reactor. Author

N71-24540*# Atomics International, Canoga Park, Calif.
CRICET: A SYSTEM FOR REMOTE MEASUREMENT OF FUEL ELEMENT TEMPERATURES
J. S. Buck *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 583-594 (See N71-24501 13-22)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18D

The CRICET system has been devised to remotely monitor temperature distributions within individual experimental fuel elements located in fast and thermal reactor cores. The system design is unique in that no in-vessel instrumentation leads or vessel penetrations are used to accomplish this function. Self-contained compact transmitter units are included within the structures of individual fuel elements. During reactor operation the transmitter sends a pulsed acoustic signal, with a pulse frequency proportional to the temperature measure, to acoustic pickups and noise analysis instrumentation outside the vessel. Author (NSA)

N71-24544*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A RETRACTABLE REPLACEABLE THERMOCOUPLE FOR INPILE EXPERIMENTS
James D. Heckelman *In its* Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 652-668 ref (See N71-24501 13-22)
(E-5227) Avail: NTIS HC$9.00/MF$0.95 CSCL 18D

A design which allows the replacement of an in-core high temperature thermocouple located in an experimental capsule of a reactor has been developed, tested, and qualified for in-core use. The design is acceptable for fueled capsules, which require double containment. The thermocouple is remotely retractable so that it can be stored in a low temperature, low neutron flux zone to prolong its life. Author (NSA)

N71-24577*# DBA Systems, Inc., Melbourne, Fla.
THE ANALYTICAL AEROTRIANGULATION OF THE APOLLO 10 HASSELBLAD PHOTOGRAPHY Final Report
Maurice S. Gyer 2 Nov. 1970 46 p refs
(Contract NAS9-9993)
(NASA-CR-115001) Avail: NTIS CSCL 14E

A strip of 75 80mm focal length Hasselblad photographs of the far side of the Moon, acquired during revolution 23 of the APOLLO 10 mission, was simultaneously adjusted using a modified version of the SURBAT (Simultaneous Unlimited Rigorous Block Analytical Triangulation) Program. The external information available for defining the scale, position, and orientation of the strip consisted of the following: (1) spacecraft position and velocity at 10 second intervals, (2) camera orientation angles derived from the spacecraft attitude determination system, and (3) two control points located near the 12th and the 110th photographs of the strip. Author

N71-24820*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MEASURED DRIFT OF IRRADIATED AND UNIRRADIATED W-3 PERCENT Re/W-25 PERCENT Re THERMOCOUPLES AT A NOMINAL 2000 K
J. D. Heckelman and R. P. Kozar [1971] 33 p refs Proposed for presentation at the 5th Symp. on Temp., Washington, D.C., 21–24 Jun. 1971
(NASA-TM-X-67818) Avail: NTIS CSCL 14B

Seven tantalum sheathed, BeO insulated, 0.157 cm diameter, grounded junction W3%Re/W25%Re thermocouples were irradiated in a helium-argon environment, at a temperature of 1900 to 2100 K. Six other thermocouples from the same lot were operated out-of-pile with the same temperature history as the in-pile thermocouples. Drift in-pile was determined by periodically replacing a reference thermocouple in the irradiation capsule. Drift out-of-pile was determined with an optical pyrometer. After 5000 hours irradiation, the estimated neutron fluence was 2×10 to the 21st power thermal neutrons sq cm and 0.4×10 to the 21st power fast neutrons/sq cm ($E > 0.18$ MeV). At this time the in-pile group had decreased in output the equivalent of 190 K at 2073 K and the out-of-pile group had decreased in output the equivalent of 54 K at 2073 K. The maximum deviation in drift between thermocouples of each group was $<$ + or − 10 K. Author

N71-24893* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
INTERNAL FLARE ANGLE GAUGE Patent
Norman D. Elder and William A. Wall, Jr., inventors (to NASA) Issued 2 Jan. 1968 (Filed 2 Jun. 1967) 7 p Cl. 33-174
(NASA-Case-XMF-04415; US-Patent-3,360,864;
US-Patent-Appl-SN-644446) Avail: US Patent Office CSCL 14B

A gage for measuring the internal angle of a flare on the end of a tube is described. The gage includes a base, a tube holding means mounted on one end of the base, a plunger actuated dial indicator on the other end, and a support block mounted between. The gage also has a differential ball device comprising a short shaft having a sphere attached to each end, one of the spheres being larger than the other. The shaft is positioned on the support block such that one sphere abuts the tube flare and the other sphere abuts the dial indicator plunger. The gage should include a plurality of differential ball devices to permit the gaging of various tube sizes. Official Gazette of the U.S. Patent Office

N71-24779*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GAMMA RAY TELESCOPES, APPENDIX
Donald Kniffen *In its* Cosmic Gamma Rays 1971 p 225–243 refs (See N71-24764 13-29)
Avail: SOD $1.25; NTIS CSCL 14B

Current instrumentation, being used or planned, to be ground-based or borne by high altitude balloons, sounding rockets, and satellites are described. The telescope types are scintillator-Cerenkov detector telescopes, nuclear emulsion and spark chamber pictorial-type detectors, gas Cerenkov detectors, and ground-based night-sky Cerenkov telescopes for 0.1 to 1 TeV gamma ray observations. The type of results, disadvantages, and advantages of each are indicated. N.E.N.

N71-24809* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CAVITY RADIOMETER Patent
Floyd C. Haley, inventor (to NASA) Issued 30 Dec. 1969 (Filed 14 Aug. 1967) 9 p Cl. 250-84; Int. Cl. H01j35/00, 37/00, 39/12 Sponsored by NASA
(NASA-Case-XNP-08961; US-Patent-3,487,216;
US-Patent-Appl-SN-661170) Avail: US Patent Office CSCL 14B

A black body cavity radiometer is described wherein the black body cavity is a thin shell formed of a thermally sensitive resistance wire to obtain rapid response. The resistance of the cone, which indicates its temperature, is measured by a bridge, and the unbalance of the bridge is highly amplified and used to drive the bridge (including the arm containing the cone). Accordingly, large currents flow through the cone until the bridge is balanced and response is very rapid. Official Gazette of the U.S. Patent Office

N71-24864* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLOW ANGLE SENSOR AND READOUT SYSTEM Patent
Victor S. Peterson and Irving G. Hansen, inventors (to NASA) Issued 8 Dec. 1970 (Filed 30 Dec. 1966) 6 p Cl. 250-225; Int. Cl. H03k13/00
(NASA-Case-XLE-04503; US-Patent-3,546,471;
US-Patent-Appl-SN-606463) Avail: US Patent Office CSCL 14B

A flow angle readout system having a polarizing light disc is described. The system is interposed between a source of rotating plane polarized light and a light sensitive resistor connected in circuit with a resistor and a dc source to produce a timewise variable voltage. The voltage is controlled by the position of a flow vane attached to the polarizing filter disc and subject to a swirling fluid in a duct. A phase meter is connected to the resistor and to a reference source of varying amplitude voltage to measure the phase angle between the voltages, which phase angle is indicative of the flow vane position, and the fluid flow angle. Official Gazette of the U.S. Patent Office

N71-24867# Joint Inst. for Nuclear Research, Dubna (USSR).
PROPORTIONAL CHAMBER FOR COMPENSATION OF COUNTER GEOMETRY IN THE TIME OF FLIGHT MEASUREMENTS
Yu. V. Zanevskii, V. D. Peshekhonov, A. I. Turala, and Z. Tsisek 1970 11 p refs In RUSSIAN
(JINR-P13-5472) Avail: AEC Depository Libraries

The compensation for counter geometry in time of flight spectrometers using a proportional chamber is described. The proposed method reduces completely the effect of the counter geometry on the time resolution of the negative pion spectrometer. Author (NSA)

N71-24966*# California Univ., Riverside. Dept. of Geography.
MULTISPECTRAL SEPARATIONS FROM MULTILAYER FILMS
Robert W. Pease Dec. 1969 27 p refs Prepared for US Geol. Surv.
(NASA Order W-12782)
(NASA-CR-118316; PB-195498; USGS-196) Avail: NTIS CSCL 14B

The practicality of deriving black and white multispectral images from multilayer color infrared film is investigated. The technique of separation involves confining light by means of a

separation filter to a very narrow spectral band which matches the maximum density wavelengths of a layer modulation being extracted and in which the dye densities of the unwanted layers are low. Errors inherent in the technique are of a low order of magnitude and result not only from interlayer interference during the separation process but from overlap of dye-forming layer sensitivities characteristic of color infrared film as well. When used as inputs to the IDECS image analyzing instrument, the black and white transparencies separated from a color infrared original performed as well or better than multispectral images originally exposed onto black and white film. Author (GRA)

N71-25052# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Abteilung Spektroskopie.

INVESTIGATION FOR CONTINUOUS MEASUREMENT OF FLAME-TEMPERATURES IN PREMIXED H2/O2-FLAMES BY MEANS OF THE TWO-LINE-METHOD [UNTERSUCHUNG ZUR KONTINUIERLICHEN TEMPERATURMESSUNG IN FLAMMEN MIT DER ZWEILINIENMETHODE]

Wilhelm Setz Dec. 1970 32 p refs In GERMAN; ENGLISH summary

(DLR-FB-70-76) Avail: NTIS; ZLDI Munich: 10.30 DM

A simple burner, operating at small flow rates, has been developed to investigate condensation reactions in premixed H2/O2 flames with metal compounds. Temperature was measured spectroscopically applying the two-line-method. Intensities of two spectrum lines Li 6 707 and Li 6 103 were recorded simultaneously using two photomultipliers in the focal plane of a prism-spectrograph. Premixed flame-gases were seeded with traces of lithium chloride vapor generated in a furnace. The results show a dependence of temperature along the flame-axis varying with the H2/O2 mixture ratio. The highest temperature measured (nonthermal) was 3500 K in the reaction zone while the temperature drops to 2500 K, 25 mm above the burner surface. The maximum equilibrium temperature was about 2650 K at a distance of some millimeters above the burner. This method of temperature determination is sensitive and reliable for continuous temperature control in flames. Deviations of temperatures as small as 25 K are detectable. Author (ESRO)

N71-25083*# Massachusetts Inst. of Tech., Cambridge.

QUARTERLY REPORT OF THE HAYSTACK OBSERVATORY

15 Jan. 1971 39 p refs Prepared for Northeast Radio Obs. Corp.

(Contract NAS9-7830; Grants NGR-22-174-003; NSF GP-16918; NSF GP-25865)

(NASA-CR-114969; QR-1) Avail: NTIS CSCL 14B

The Goldstone–Haystack interferometer provided the basis for confirmation of the gravitational bending predictions of the theory of general relativity. The technique is also being developed into a powerful tool for geodetic measurements and for the high resolution analysis of complex radio sources. Spectral line observations have received added impetus by the completion of a new high-speed 100-channel digital correlator which affords a 20-MHz window at maximum clock rate. An X-band radar interferometer using Haystack and a 60-foot reflector of MIT Lincoln Laboratory located 4000 feet away has been used to demonstrate the measurement of lunar topography with an error of a few hundred meters. Improvements in signal processing methods and computer analysis of planetary radar data are making possible improved estimates for the over-all geometric shape of the equatorial regions on Mercury and Venus; indeed, resolution of relatively small topographical features is proving possible in the case of Venus. A new hardware signal decoder has also been completed. Author

N71-25119# National Accelerator Lab., Batavia, Ill.

DIFFERENTIAL THRESHOLD CERENKOV COUNTER

Yu. D. Prokoshkin [1970] 9 p refs Transl. into ENGLISH of Gos. Kom. po Ispolz. At. Energii SSSR, Serpukhov, Inst. Fiz. Vysokikh Energii, report IHEP-69-7

(NAL-tr-1; IHEP-69-7) Avail: NTIS

The differential treshold counter, which is a modification of the Cherenkov counter, is described. This differential threshold counter combines high resolution with a large angular aperture. The counter is a Cherenkov threshold counter in which the output pulses of the photomultiplier are discriminated in a narrow band, and only those pulses are counted which correspond to the knockout of a small number of photoelectrons from the photomutiplier photocathode. The pulse height spectra for various gas pressures and the corresponding different mean values of the number of photoelectrons are calculated. The counter efficiency and pressure curves are also shown. NSA

N71-25193# Edgerton, Germeshausen and Grier, Inc.

STUDY OF DIFFRACTION AND DRAG IN THE MODEL 739 FRAMING CAMERA

Arthur Pierson Apr. 1970 23 p ref

(Contract AT(29-1)-1183)

(EGG-1183-530; B-4178) Avail: NTIS

Camera performance predictions were derived by analyzing drag and diffraction image degradation sources. Two study methods and results are described. The results of the two methods are significantly different; an exact approach yields higher values of resolution; and a resolution of 30 lines/mm can be realized over the greater part of the writing time. Low contrast implies that stray light and scattering may drastically degrade the performance. Author

N71-25251*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

LONG TERM DRIFT OF SOME NOBLE AND REFRACTORY METAL THERMOCOUPLES AT 1600 K IN AIR, ARGON, AND VACUUM

G. E. Glawe and A. J. Szaniszlo [1971] 41 p refs Presented at 5th Symp. on Temp., Its Meas. and Control in Sci. and Ind., Washington, D.C., 21-24 Jun. 1971; sponsored by Am. Inst. of Phys., Instr. Soc. of Am., and NBS

(NASA-TM-X-67813) Avail: NTIS CSCL 14B

Thermal emf changes (drift) for 38 pairs of thermocouples using high-purity alumina insulators were determined at 1500 to 1600 K for times periods up to 10,000 hr. Wire sizes ranged from 0.3 to 1.1 mm diam with 0.5 mm being the most common size. In air, the maximum drift of 87Pt13Rh/Pt thermocouples, for 10,000 hr, was −5 K (lower emf). In argon, 87Pt13Rh/Pt and 95W5Re/74W26Re pairs with 0.5 mm wires drifted about -22 K for 10,000 h; 70Pt30Rh/94Pt6Rh pairs of the same diameter drifted about −12 K; and smaller diameter (0.33 mm) noble-metal pairs behaved erratically, with drifts of up to −72 K. In one vacuum test system most noble-metal thermocouples failed within a few thousand hr, after less than −4 K drift; in a second test system, 87Pt13Rh/Pt pairs (0.5 mm diam) drifted −3 K at 3700 hr without failures. Testing of the W-Re alloy thermocouples in a vacuum was terminated at 3800 hr by failure of tantalum test capsules; at 3800 hr, drift was −16 K. Test-induced chemical and physical changes of the materials were determined by emission and mass spectrometry, photomicrography, hardness tests and electrical resistivity measurements. Author

N71-25257*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MULTISPECTRAL TERRAIN PHOTOGRAPHY FROM APOLLO 9

Paul Lowman *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 5–10 Original contains color illustrations (See N71-23236 13-34)

Avail: NTIS HC $6.00/MF $0.95 CSCL 14E

Four coaxially mounted cameras on Apollo 9 were used simultaneously in multispectral terrain photography for earth resources purposes. The electrically driven equipment utilized different film-filter combinations and was mounted in the hatch window of the command module. Results show that: (1) black and white film with a red filter is best for topographical mapping because of its high resolution; (2) colored infrared film provides the best general purpose pictures; and (3) colored film depicts optimal regional geological structures. G.G.

N71-25327*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AN OPTICAL TELESCOPE FOR SPACE ASTRONOMY

John D. Mangus *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 295-298 (See N71-25256 13-34)

Avail: NTIS HC$6.00/MF$0.95 CSCL 17H

Design and fabrication of the extreme ultraviolet spectroheliographic telescope to be flown on OSO H are reported; the instrument is approximately 2 in. in diameter and has an effective focal length of 85 cm. Test data on two model telescopes indicate that they have a resolving power of 5 to 10 seconds of arc at 304 A. G.G.

N71-25329*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

OPTICAL COATINGS FOR SPACE ASTRONOMY

John F. Osantowski *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 302-305 ref (See N71-25256 13-34)

Avail: NTIS HC$6.00/MF$0.95 CSCL 17H

The state-of-the-art in UV optical coatings is discussed with emphasis on: (1) deposition of LiF-protected Al on a prototype primary mirror; (2) studies of UV reflectance filters; and (3) evaluation of MgF2-protected Al for use in the wavelength region below 1000 A. G.G.

N71-25340*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AN ELECTRON BEAM RECORDER FOR SPACE APPLICATIONS DATA

Harvey Ostrow *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 350 353 (See N71-25256 13-34)

Avail: NTIS HC$6.00/MF$0.95 CSCL 14B

The performance characteristics of an electron beam recorder for the ATS spin-scan camera system are reported. The system uses electron strikes on silver-halide photographic material to produce a latent image that is subsequently developed by usual film processing techniques. Resolutions of 4000 TV lines at 90% response and 8000 TV lines at 70% response have been measured on a 70-mm format recording; this represents a limiting resolution of more than 16,000 TV lines. Scan linearity of better than 0.2% in both directions and a dynamic range of 200:1 have been achieved and recorded densities of up to 3.0 provide more than 20 shades of gray. G.G.

N71-25369# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

EFFECTS OF FAST NEUTRON IRRADIATION ON THERMOCOUPLES

N. C. Hoitink and R. C. Weddle 7 May 1970 14 p refs Presented at 1970 IEEE Conf. on Nucl. and Space Radiation Effects, San Diego, Calif., 21-23 Jul. 1970

(Contract AT(45-1)-1830)

(WHAN-SA-10; CONF-700713-1) Avail: NTIS

As part of a program aimed at establishing performance characteristics of thermocouples to assure reliable sensors for measuring coolant temperature in the Fast Test Reactor (FTR) thermal and nuclear environment, 22 Chromel/Alumel thermocouples were tested before and after exposure in the EBR-2 nuclear reactor. The 30 in. long, 0.0625-in. diameter, stainless-steel-sheathed, MgO-insulated thermocouples included both grounded- and insulated-junction types. Very little information exists regarding fast neutron exposures beyond about 10 to the 20th power nvt, and since thermocouples for use in the FTR may experience exposures between 10 to the 21st power and 10 to the 22nd power nvt, the described program emphasizes the determination of the type and extent of fast neutron damage. Effects on the sensor from fast neutron irradiation may include calibration shifts, wire resistance changes, response time changes, and variations in insulation resistance. Author (NSA)

N71-25370# California Univ., La Jolla. Dept. of Physics.

ENAMEL: MAGNETIC THERMOMETER USEFUL INTO THE MILLIDEGREE REGION

E. C. Hirschkoff, O. G. Symko, and J. C. Wheatley [1970] 10 p refs

(Contract AT(04-3)-34)

(UCSD-34-P-143-34) Avail: NTIS

The static, temperature-dependent magnetization of enameled niobium wire was measured. The enamel itself shows great promise as a magnetic thermometer useful into the millidegree range. Author

N71-25403# National Accelerator Lab., Batavia, Ill.

HIGH RESOLUTION DIFFERENTIAL CERENKOV COUNTERS

Yu. P. Gorin et al [1971] 14 p refs Transl. into ENGLISH of Gos. Komitet po Ispolz. At. Energii SSSR, Serpukhov, USSR, report IHEP-70-48

(NAL-tr-3; IHEP-70-48) Avail: NTIS

Differential Cherenkov gas counters detecting Cherenkov light at angles theta = 12 and 23 mrad are described. The counter lengths are 5 m (theta = 23 mrad) and 10 m (theta = 12 mrad). The spectral band is 250 to 600 nm (2500 to 6000 A), and the counting gas is helium. The counter characteristics were investigated in particle beams of the 70-GeV IHFE with momenta of 35, 40, and 45 GeV/c. The velocity resolution was measured as 2 × 100,000 for the 10-m counter and 6 × 100,000 for the 5-m counter. The 10-m counter can be utilized to separate pions and kaons with momenta of up to approximately 200 GeV/c, and kaons and protons (antiprotons) with momenta of up to approximately 350 GeV/c. Author (NSA)

N71-25404# Oak Ridge National Lab., Tenn.

SPECTRUM MEASUREMENTS OF RADIOACTIVE NEUTRON SOURCES IN THE 10 keV-10MeV ENERGY REGION WITH PROTON-RECOIL PROPORTIONAL COUNTERS

H. Werle [1971] 106 p refs Transl. into ENGLISH of Kernforschungzentrum, Karlsruhe, West Ger., rept. NP-18359; INR-4170-25

(ORNL-tr-2415; NP-18359; INR-4170-25) Avail: NTIS

Proton recoil proportional counters were used for several years with success for neutron spectrum measurements in the energy range between about 20 keV and 1.5 MeV. It is shown by measurements with monoenergetic neutrons and by comparison measurements with other methods, that with proton recoil counters reliable measurements are also possible below 20 keV and in the energy range between 1.5 and 10 MeV. The spectra of most of the normally used, radioactive neutron sources (alpha,n-sources: Ra-Be, Am-Be, Am-B, Am-(B-10), Am-F, Am-Li, and Cf-252 spontaneous fission source) were measured in the whole interesting energy range, especially also in the range below 1 to 2 MeV; and influence of the size of the radioactive particles on the neutron spectrum was proved experimentally. The differential neutron spectrum of a Sb-Be (gamma,n)-source can be determined for the first time with good accuracy, in spite of the very high

gamma-background, by using the gamma-n-discrimination technique.
Author (NSA)

N71-25405# Los Alamos Scientific Lab., N.Mex.
APPARATUS FOR PLASTICITY EXPERIMENTS UNDER BIAXIAL STRESSES
S. S. Hecker, B. G. Strait, and R. M. Lang Aug. 1970 8 p refs
(Contract W-7405-eng-36)
(LA-4550) Avail: NTIS

An apparatus that produces biaxial stresses in thin-walled tubes by subjecting them to simultaneous internal pressure and independent axial load is described. The axial load is applied and controlled by an Instron testing machine, and the internal pressure is controlled by an electric stepping motor that permits greater simplicity and versatility of operation than do conventional systems. The experimental methods used in conducting constant- and variable-stress-ratio tests and cyclic loading tests, all of which are important in studying the plastic deformation of materials, are discussed. Author

N71-25510# von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
A NON-CONTACTING PROBE FOR PISTON KINEMATIC MEASUREMENTS
P. L. Clemens Mar. 1971 33 p refs
(VKI-TM-21) Avail: NTIS

Non-contacting, variable reluctance probes of simple design and construction are applicable to measurements of piston kinematics in pump tubes, overcoming such disadvantages of previous methods as the need for shot-by-shot refurbishment, sometimes erratic performance, and expense. The new probe produces signals adequate for triggering oscilloscopes and gating chronographs. Its accuracy and resolution are expected to be at least equal to those obtained with shorting probes and pressure transducers. A small piston ring of magnetic material must be used with the probe. Use of more than one ring enables measurement of piston velocity at each probe rather than averaged over widely separated stations as with earlier probe methods. Author

N71-25511 Department of Energy, Mines and Resources, Ottawa (Ontario). Earth Physics Branch.
THE CANADIAN PENDULUM APPARATUS, DESIGN AND OPERATION, VOLUME 41, NO. 4
H. D. Valliant 1971 22 p refs
Copyright. Avail: Issuing Activity

A bi-pendulum apparatus which uses bronze pendulums has recently been developed for relative gravity measurements. Variable factors such as temperature, pressure, humidity, amplitude, and time, are precisely controlled to minimize the corrections required to reduce the periods to identical conditions. Rigorous testing of the equipment under laboratory and simulated field conditions disclosed that systematic errors in measuring gravity differences would not exceed 0.06 mgal and random errors would not exceed 0.20 mgal r.m.s. Tests under complete field conditions along the North American Calibration Line resulted in a mean difference between gravimeter and pendulum values of 0.04 mgal and an r.m.s. difference of 0.06 mgal. Agreement with absolute measurements is within the error bounds estimated for these two instruments. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N71-24376# Army Foreign Science and Technology Center, Charlottesville, Va.
PREVENTION AND ELIMINATION OF VIBRATION IN ROTARY MACHINES
S. I. Lipsman et al 3 Jun. 1970 213 p refs Transl. into ENGLISH of the publ. 'Preduprezhdeniye i Ustraneniye Vibratsii Rotornykh Mashin' Kiev, Tekhn. Press, 1968 p 1-196
(AD-719501; FSTC-HT-23-455-70) Avail: NTIS CSCL 13/9

A practical guide is presented for the prevention and elimination of vibrations in rotary machines of various types, fans and exhaust fans, turbine compressors and air blowers, electrical generators and engines, steam, gas and hydraulic turbines, centrifuges and separators, disintegrators and high speed mills, etc. The book contains information on determination of the causes of vibration, descriptions of means, devices and mechanisms which are used in eliminating vibrations. Author (GRA)

N71-24379# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
MAINTENANCE TOOL SETS, AVIATION Final Report
16 Dec. 1970 20 p
(AD-719103; MTP-7-3-057) Avail: NTIS CSCL 13/9

Procedures are described for evaluating the adequacy of maintenance tools sets. Considerations of tool set durability and compatibility with aircraft maintenance characteristics are discussed. (Author) GRA

N71-24398*# Martin Marietta Corp., Denver, Colo.
FAMILIARIZATION AND SUPPORT MANUAL FOR APOLLO LUNAR SURFACE DRILL (ALSD)
D. A. Kribs 14 Nov. 1969 267 p *Its* Issue No. 3
(Contract NAS9-9462)
(NASA-CR-114989; MCR-69-300) Avail: NTIS CSCL 13I

The ALSD Familiarization and Support Manual which contains equipment descriptions, operating procedures and support instructions necessary to maintain the Apollo Lunar Surface Drill at a field level of operation is presented. Major areas contained in the manual include: interfaces with the Apollo Lunar Surface Experiments Package (ALSEP), operational requirements, equipment descriptions with major part number identification, ALSD operating procedures, service instructions, BXA and KSC prelaunch operations, spare parts distribution, and transportation and storage requirements. Author

N71-24435# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN ENCLOSED BALANCING STAND FOR TESTING RADIAL BALL BEARINGS UNDER LOW TEMPERATURE CONDITIONS
A. A. Lyakh 23 Nov. 1970 9 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Mashinostro. (Moscow), no. 11, 1969 p 88-91
(AD-719810; FTD-HT-23-708-70) Avail: NTIS CSCL 14/2

A test stand has developed which makes it possible to simultaneously measure the total friction moment of four ball bearings, and to investigate friction losses in the ball bearings under various radial load conditions and shaft speeds, over a wide range of low temperatures down to minus 100 degrees. The stand is described in some detail, and it is designed to test medium-size ball bearings at speeds from 0 to 5,000 rpm. Radial forces up to 1500 kg can be exerted on the bearings. A balanced-bridge measuring system connected to an oscillograph through an amplifier is used to measure friction. Liquid nitrogen in a cavity adjoining the bearings is used to reduce the temperature. Author (GRA)

N71-24599* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
WINCH HAVING CABLE POSITION AND LOAD

INDICATORS Patent
Joseph A. Chandler and Thomas M. Grubbs, inventors (to NASA) Issued 8 Dec. 1970 (Filed 24 Oct. 1968) 7 p Cl. 254-150; Cl. 254-173; Cl. 254-186; Int. Cl. B66d1/30
(NASA-Case-MSC-12052-1; US-Patent-3,545,725; US-Patent-Appl-SN-770371) Avail: US Patent Office CSCL 13I

A winch that pays out and reels in cable through a fixed guide is described. The cable is wound on a helically grooved drum that is free to move axially along the longitudinal axis of its supporting shaft as required to maintain the cable coming off the drum in line with the cable guide. The bearings supporting the cable drum are located equal distances from the cable guide on opposite sides thereof so that the force imposed on the shaft by the cable is equally divided between the bearings. A strain gage is mounted on one bearing cap to indicate the reaction at this bearing due to the cable load to provide a continuous measurement of the force on the cable. The contact of a linear potentiometer is moved by the drum as it moves axially to vary an electrical signal, which is used to indicate drum position and the amount of cable payed out at any given time.
Official Gazette of the U.S. Patent Office

N71-24679* Rocketdyne, Canoga Park, Calif.
TECHNIQUE OF ELBOW BENDING SMALL JACKETED TRANSFER LINES Patent
James N. Gardner and Thomas L. Nielson, inventors (to NASA) Issued 15 Dec. 1970 (Filed 30 Sep. 1968) 5 p Cl. 72-369; Int. Cl. B21d9/00 Sponsored by NASA
(NASA-Case-XNP-10475; US-Patent-3,546,917; US-Patent-Appl-SN-763868) Avail: US Patent Office CSCL 13H

A method of forming elbows of bends in a length of jacketed pipe, such as a cryogenic transfer line is disclosed. Two lengths of tubing are coaxially assembled and the annular space between them if filled with a congealable liquid such as water. The water is frozen, preferably very quickly, by passing liquid nitrogen through the core of the inner tube. The assembly is then bent to the desired radius using conventional pipe bending techniques while maintaining the water frozen. Satisfactory spacing between the inner and outer tubing is maintained for bends up to about 90 deg. Elbows of pipe up to about 2 1/2 inch in outside diameter can be fabricated on site with portable bending machines.
Official Gazette of the U.S. Patent Office

N71-24800* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REDUNDANT ACTUATING MECHANISM Patent
Jesse M. Madey and Xopher W. Moyer, inventors (to NASA) Issued 17 Nov. 1970 (Filed 20 Dec. 1968) 8 p Cl. 244-1; Cl. 9-9; Cl. 74-2; Cl. 89-1.5; Cl. 244-150; Int. Cl. B64g1/00
(NASA-Case-XGS-08718; US-Patent-3,540,676; US-Patent-Appl-SN-785611) Avail: US Patent Office CSCL 13I

A redundant cable release mechanism for spacecraft components such as releasable despin weights and extensible gravity booms is described. The mechanism consists of a crank arm system for actuating the lever arm of a cable release.
Official Gazette of the U.S. Patent Office

N71-24694* TRW Systems Group, Redondo Beach, Calif.
PASSIVE CAGING MECHANISM Patent
Jerzy George Zaremba, inventor (to NASA) Issued 3 Nov. 1970 (Filed 11 Feb. 1969) 8 p Cl. 248-358; Int. Cl. F16f13/02, 15/00 Sponsored by NASA
(NASA-Case-GSC-10306-1; US-Patent-3,537,672; US-Patent-Appl-SN-798278) Avail: US Patent Office CSCL 13I

A caging mechanism for protecting the gimbals of a guidance system from vibrations generated during launch of a spacecraft is described. The system has a three stage passive vibration damper including a circumferentially spaced plurality of spring hoops mounted on a sleeve secured to and surrounding a mounting shaft for the gimbal.
Official Gazette of the U.S. Patent Office

N71-24695* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DETENTING SERVOMOTOR Patent
Gerald S. Perkins, inventor (to NASA) Issued 30 Dec. 1969 (Filed 17 May 1967) 5 p Cl. 318-382; Int. Cl. H02p3/02; 3/06 Sponsored by NASA
(NASA-Case-XNP-06936; US-Patent-3,487,281; US-Patent-Appl-SN-640786) Avail: US Patent Office CSCL 13I

A braking arrangement comprising a permanent magnet defining opposite poles supported on a shaft, coextensive with a motor's shaft is described. A pair of pole pieces are radially positioned with respect to the permanent magnet and form a magnetic yoke. When the motor is energized, a counter emf is induced by currents in short circuited windings supported on the pole pieces. This force tends to slow the shafts' rotation once the motor is de-energized. The shafts finally come to rest when the poles of the permanent magnet are aligned with the pole pieces.
Official Gazette of the U.S. Patent Office

N71-24696* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
REVERSIBLE MOTION DRIVE SYSTEM Patent
Hans L. Richter and Floyd W. Stoller, inventors (to NASA) Issued 20 Oct. 1970 (Filed 4 Feb. 1969) 6 p Cl. 310-101; Int. Cl. H02k49/00 Sponsored by NASA
(NASA-Case-NPO-10173; US-Patent-3,535,570; US-Patent-Appl-SN-796360) Avail: US Patent Office CSCL 13I

A drive system for driving a large parabolic tracking antenna in either of two opposite directions, at a uniform rate or in response to error signals is disclosed. The system incorporates a plurality of electrical loops including eddy current energized actuators to produce the desired antenna motion, and a unique solid state RF interference free current feedback amplifier. The system includes a loop to provide antibacklash biasing and load rate compensation.
Official Gazette of the U.S. Patent Office

N71-24833* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
MAGNETOMOTIVE METAL WORKING DEVICE Patent
Robert J. Schwinghamer and Leslie E. Foster, inventors (to NASA) Issued 2 Jan. 1968 (Filed 4 May 1965) 10 p Cl. 72-56
(NASA-Case-XMF-03793; US-Patent-3,360,972; US-Patent-Appl-SN-453225) Avail: US Patent Office CSCL 13I

A magnetomotive metal working portable hammer unit is described that has a reinforced flat spiral coil at one end and is electrically connected to a pair of abutting metallic electrical contact plates with an insulation block separating the coil and the contact plates. The coil, insulation block and contact plates are housed in a shell of insulating material. The various components of the hammer are clamped together by an axial bolt extending from the center of the coil to the opposite end of the hammer. Relatively long transmission lines connect the hammer to a power supply and electrical energy within the hammer passes through the contact blocks, coil and axial bolt.
Official Gazette of the U.S. Patent Office

N71-24834* Aerojet-General Corp., El Monte, Calif.
TENSILE STRENGTH TESTING DEVICE Patent
Robert N. Hanson, inventor (to NASA) Issued 12 Aug. 1969 (Filed 27 Dec. 1966) 5 p Cl. 73-95; Int. Cl. G01n3/28, 3/08 Sponsored by NASA
(NASA-Case-XNP-05634; US-Patent-3,460,379; US-Patent-Appl-SN-605096) Avail: US Patent Office CSCL 13I

A testing device is reported that is usable with a conventional uniaxial force tensile testing machine. It converts the tensile testing machine from one that produces a uniaxial force to one that exerts many forces on a test specimen from various selected directions. The testing device includes flexible members that interconnect the rams of the tensile testing machine and the test specimen, and a fixture carrying a number of guides. The guides position the flexible members in the direction it is desired to apply the forces on the test specimen. Moving the rams of the tensile testing

machine apart causes the flexible members to exert forces in the desired directions on the test specimen.
Official Gazette of the U.S. Patent Office

N71-24835* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FLUID CONTAINERS AND RESEALABLE SEPTUM THEREFOR Patent
Samuel B. Wheeler, inventor (to NASA) Issued 17 Nov. 1970 (Filed 23 May 1968) 8 p Cl. 128-272; Cl. 128-275; Int. Cl. A61j1/00 Sponsored by NASA
(NASA-Case-NPO-10123; US-Patent-3,540,449; US-Patent-Appl-SN-731388) Avail: US Patent Office CSCL 13D

Fluid containers with resealable septum are provided by fabricating the containers from preformed sheets made of polyester fiber material coated with a composition containing organosilicon polymers. The sheets are fused, or cemented together along their margins, with plastic inlet and outlet tubes in between. An outlet tube extends into each container a substantial distance and is provided with a plurality of perforations. A resealable septum is connected to the tubes of the containers for insertion or withdrawal of fluids with hypodermic syringes.
Official Gazette of the U.S. Patent Office

N71-24836* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
APPARATUS FOR MAKING CURVED REFLECTORS Patent
Austin F. Reader, Walter E. Russell, and Edward A. Werner, inventors (to NASA) Issued 24 Nov. 1970 (Filed 26 May 1969) 6 p Cl. 72-60; Int. Cl. B21d11/10, 11/20 Continuation-in-part of US Patent Appl. SN-662829, filed 23 Aug. 1967
(NASA-Case-XLE-08917-2; US-Patent-3,541,825; US-Patent-Appl-SN-852131) Avail: US Patent Office CSCL 13M

Fabricating and forming each curved segment of a light weight mirror by polishing one surface of a flat magnesium plate and then machining stiffening ribs in the other side is described. Each plate is accurately formed on a single mold with the application of heat and pressure after the machining
Official Gazette of the U.S. Patent Office

N71-24865* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
METHOD AND APPARATUS FOR PRECISION SIZING AND JOINING OF LARGE DIAMETER TUBES Patent
Robert J. Schwinghamer and J. D. Bennight, inventors (to NASA) Issued 17 Nov. 1970 (Filed 27 Jun. 1969) 13 p Cl. 72-56; Int. Cl. B21d26/14 Continuation-in-part of US Patent Appl. SN-637882, filed 8 May 1967
(NASA-Case-XMF-05114-3; US-Patent-3,540,250; US-Patent-Appl-SN-837378) Avail: US Patent Office CSCL 13H

A method and apparatus for portable high precision magnetomotive bulging, constricting, and joining of large diameter tubes are discussed. The method allows decremental, very accurate changing of the diameter of very large tubes, as well as high quality joints obtained by either bulging or constricting overlapping ends of two tubes. The apparatus consists of a magnetomotive coil positioned either inside or outside of the tube and a non-conducting mandrel (or forming die) on the other side. The magnetomotive coil has square conductors which are recessed, and thus separated by an air gap, from the tube. The constricting coil has a split metal sleeve for withstanding hoop stress. The tube (workpiece) is insulated from the coil by a thin plastic sleeve. The power supply is an electrically floating system.
Official Gazette of the U.S. Patent Office

N71-24875* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PROCESS FOR APPLYING BLACK COATING TO METALS Patent
Beverly W. Lewis and Donald J. Progar, inventors (to NASA) Issued 17 Nov. 1970 (Filed 5 Feb. 1968) 6 p Cl. 148-6.11; Int. Cl. C23f7/02
(NASA-Case-XLA-06199; US-Patent-3,540,942; US-Patent-Appl-SN-702911) Avail: US Patent Office CSCL 13H

High thermal emittance black coatings and a process for applying them to metals and metal alloys for use in radiative cooling of spacecraft, including space power systems and the like are discussed. The coatings are capable of obtaining a measured emittance of approximately 0.96. The black coating is applied by treating a flame sprayed nickel coating with a solution of metallic salts followed by reacting the surface with molten sodium or potassium dichromate. Official Gazette of the U.S. Patent Office

N71-24895* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VELOCITY LIMITING SAFETY SYSTEM Patent
Harlan K. Holmes, inventor (to NASA) Issued 8 Dec. 1970 (Filed 8 Jul. 1969) 7 p Cl. 318-265; Int. Cl. H02p5/00
(NASA-Case-XLA-07473; US-Patent-3,546,552; US-Patent-Appl-SN-839935) Avail: US Patent Office CSCL 13I

A safety system is described that limits the velocity of a vehicle that is moved by a motor. The limiting velocity is determined by the position of the moving vehicle. The motor, in addition to being connected to the vehicle, is coupled to a generator and to the slider of a potentiometer. The generator and the potentiometer are connected in an electrical circuit with two switching diodes and a meter relay such that the current through the coil of the meter is dependent on both the position and velocity of the vehicle. When the current through the coil exceeds a predetermined value, a switch is actuated causing the power to the motor to be cut off. Official Gazette of the U.S Patent Office

N71-24896* National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
LEAK DETECTOR WHEREIN A PROBE IS MONITORED WITH ULTRAVIOLET RADIATION Patent
Alfred E. Barrington, inventor (to NASA) Issued 22 Dec. 1970 (Filed 30 Sep. 1968) 5 p Cl. 250-43.5; Int. Cl. G01n21/26
(NASA-Case-ERC-10034; US-Patent-3,549,882; US-Patent-Appl-SN-763706) Avail: US Patent Office CSCL 14D

A method and apparatus are described for detecting leaks in an evacuated system by utilizing a stream of probe gas, preferably one taken from the Group 0 (zero) elements of the Periodic table. The probe gas is one having an intense resonance line in the vacuum ultraviolet region of the spectrum. The invention communicates with the evacuated system by means of an opening in the vacuum line into which is placed a sample cell element together with a beam of light, containing ultraviolet radiation, for continuously monitoring the system for leaks. The beam of light has a wavelength substantially equal to about the wavelength of the resonance line for the probe gas, so that when a probe gas is present in the system, light from the beam will be scattered and detected. Official Gazette of the U.S. Patent Office

N71-24897* Ling-Temco-Vought, Inc., Dallas, Tex.
LATCH/EJECTOR UNIT Patent
Stuart K. Edleson, inventor (to NASA) Issued 28 Apr. 1970 (Filed 31 Jul. 1968) 6 p Cl. 294-83; Int. Cl. B64d1/02 Sponsored by NASA
(NASA-Case-XLA-03538; US-Patent-3,508,779; US-Patent-Appl-SN-749149) Avail: US Patent Office CSCL 13E

A latching mechanism is described featuring a pivoting but positively engaging and quick-releasing catch, combined with a self-contained spring ejection arrangement for the latched members. Official Gazette of the U.S. Patent Office

N71-24903* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

DUCT COUPLING FOR SINGLE-HANDED OPERATION Patent

William N. Myers, inventor (to NASA) Issued 8 Dec. 1970 (Filed 5 Jun. 1969) 5 p Cl. 285-38; Cl. 285-317; Cl. 285-314; Cl. 285-406; Int. Cl. F16l37/10

(NASA-Case-MFS-20395; US-Patent-3,545,792; US-Patent-Appl-SN-830715) Avail: US Patent Office CSCL 13I

A quick disconnect duct coupling device is described which may be operated with the use of one hand in a zero gravity environment. A first duct section carries spring-urged latches that engage a second duct section. The latches are spring-biased toward the locking position and are moved to the unlocking position by the rotation of a ring mounted on the first duct section. The ring is rotated by manipulation of a handle that is associated with the ring and the first duct section.

Official Gazette of the U.S. Patent Office

N71-24910* National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

METHOD FOR DETECTING LEAKS IN HERMETICALLY SEALED CONTAINERS Patent

Irving Litant, inventor (to NASA) Issued 22 Dec. 1970 (Filed 30 Sep. 1968) 5 p Cl. 73-40.7; Int. Cl. G01m3/06, 3/20

(NASA-Case-ERC-10045; US-Patent-3,548,636; US-Patent-Appl-SN-763685) Avail: US Patent Office CSCL 14D

A leak detection method wherein the hermetically sealed container is vacuum heated and then immersed in a relatively cool bath of a detection fluid such as trichlorofluoromethane is discussed. Should leaks exist the detection fluid is drawn to the interior of the container by the resulting reduction of pressure. After all traces of the fluid are removed from the surface of the container, leaks are detected by means of a halogen detector or by observance of bubbles when the container is immersed in a second liquid.

Official Gazette of the U.S. Patent Office

N71-24965 Stanford Univ., Calif.

THE MOBILITY OF LINKAGES

Kenneth John Waldron (Ph.D. Thesis) 1969 138 p

Avail: Univ. Microfilms Order No. 70-10544

A discussion of linkage mobility and the relationship between constraint analysis and displacement analysis is presented. The discussion includes: (1) The development of a method of determining instantaneous linkage mobility based on consideration of small perturbations from a given linkage position. This method utilizes instantaneous screw axis theory to allow derivation of results geometrically. (2) Use of this method to derive a large number of previously unknown overconstrained linkages. The linkages derived are of three classes. (3) Derivation of all two and three bar single loop overconstrained linkages whose joints are all lower pairs, and of all such four bars, with the exception of those containing screw joints. This is accomplished by direct solution of the linkage closure equations. Several previously unknown C-R-C-R- and F-R-R-R- linkages are found among the solutions. Dissert. Abstr.

N71-24967*# National Aeronautics and Space Administration. Washington, D.C.

PACKAGING AND CONTAINER TECHNOLOGY: A COMPILATION

1970 14 p refs

(NASA-SP-5923(01)) Avail: NTIS CSCL 13D

Brief summaries on packaging techniques and assemblies, and containers and related devices are presented for potential technology utilization outside the aerospace industry. Packaging criteria, impact and puncture resistant coverings, protective covers for large delicate equipment, plastic hoops for thermocouple packaging, rubber and plastic foam packaging, detonating fuze assembly, ultrasonic cleaning containers, air-pillow-pack container, seal-off device for evacuating air, reusable containers, self-sealing closure for fluid containers, serum bottle capper, pressure vessel door, reversible tool chest, and container drains are reported. N.E.N.

N71-24977# National Bureau of Standards, Washington, D.C. Inst. for Applied Technology.

AN INDEX OF US VOLUNTARY ENGINEERING STANDARDS COVERING THOSE STANDARDS, SPECIFICATIONS, TEST METHODS, AND RECOMMENDED PRACTICES ISSUED BY NATIONAL STANDARDIZATION ORGANIZATIONS IN THE UNITED STATES

William J. Slattery, ed. Mar. 1971 1002 p refs

(NBS-Spec-Publ-329) Avail: SOD $9.00 Catalogue No. C-13.10:329 CSCL 13H

This computer-produced index contains the permuted titles of more than 19,000 voluntary engineering and related standards, specifications, test methods, and recommended practices, in effect as of 31 December 1969, published by some 360 U.S. technical societies, professional organizations, and trade associations. The key-word-in-context (KWIC) method of indexing is used. Author

N71-24984* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SELF-LUBRICATING GEARS AND OTHER MECHANICAL PARTS Patent

Keith E. Demorest, inventor (to NASA) Issued 24 Nov. 1970 (Filed 26 May 1969) 6 p Cl. 74-468; Int. Cl. F16h55/12, 57/04

(NASA-Case-MFS-14971; US-Patent-3,541,875; US-Patent-Appl-SN-827579) Avail: US Patent Office CSCL 13I

Gears and other mechanical parts are constructed of alternating layers of metal and a dry-lubricant-containing material bonded into a laminated composite body. The lubricating layers extend through the body of the part so that exposed portions thereof form a part of the contacting surfaces. Disposition of the lubricating layers diagonally with respect to frictional contacting surfaces provides for continuous distribution of a lubricating film by lateral movement of the exposed lubricating portion over the opposing surface with rotation of the part. Official Gazette of the U.S. Patent Office

N71-25026*# National Aeronautics and Space Administration. Washington, D.C.

BONDING AND JOINING TECHNOLOGY: A COMPILATION

1970 24 p refs

(NASA-SP-5925(01)) Avail: NTIS CSCL 13H

This compilation covers a broad range of technical information in the fields of metallurgy, electrical repair, fabrication techniques for coatings, bonding and brazing, and several special items concerned with electron beam welding. The information varies considerably in technical detail, but is intended primarily for skilled technicians with practical experience in the specific industry where each item is used. Author

N71-25239# Joint Publications Research Service, Washington, D.C.

ELECTRON BEAM WELDER FOR SPACE

B. Ye Paton et al 12 May 1971 11 p refs Transl. into ENGLISH from Avtomat. Svarka (Ukr. SSR), no. 3, 1971 p 3-8

Avail: NTIS

Maneuverable, reliable, and safe equipment for welding and cutting thin metal sheets in outer space is described. The optoelectronic system and electron beam apparatus are discussed, along with the selection of operating parameters. Experiments were performed with 1 kW beam power in a flight laboratory and with 0.6 kW beam power in the unsealed compartment of the Soyuz 6 spacecraft. The depth and width of fusion under the conditions of weightlessness and in ground laboratories were found to be identical. Certain peculiarities in the form of the welds made in weightless conditions are noted. N.E.N.

N71-25466*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.

SPACE-STORABLE OXIDIZER VALVE Final Report

D. L. Endicott and T. R. de Gennaro Nov. 1970 161 p refs

(Contract NAS3-12029)
(NASA-CR-72690; MDC-G0729) Avail: NTIS CSCL 13G

A program to design, fabricate, and test a space-storable oxidizer valve is described. Valve design, fabrication and acceptance testing, fluorine compatibility testing, valve refurbishment and testing, and environmental testing were carried out. Author

N71-25457# Bendix Corp., Kansas City, Mo.
INSPECTION OF FINE PITCHED GEARS
C. W. Berry, Jr. [1970] 21 p
(Contract AT(29-1)-613)
(BDX-613-309) Avail: NTIS

A gear checking system for testing fine-pitched miniature metallic gears at the required 2-ounce pressure has been developed and evaluated. This system will be recommended to replace the Fellows Redliner No. 4 for inspection of battery actuator gears and other fine-pitched miniature gears. Author

N71-25508*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LUBRICATION WITH SPUTTERED MoS2 FILMS
Talivaldis Spalvins [1971] 15 p refs Proposed for presentation at Intern. Conf. on Solid Lubrication, Denver, 24-27 Aug. 1971; Sponsored by Am. Soc. of Lubrication Engr.
(NASA-TM-X-67832) Avail: NTIS CSCL 11H

Sputtered MoS2 films (2000 - 6500 A) were deposited on highly polished metal surfaces. These films have a low coefficient of friction (0.03 - 0.04) at speeds of 40 - 80 rpm and loads of 250 - 1000 grams. At loads of 250 grams the wear lives are over 0.5 million cycles, but at 1000 gram loads, it decreases to 38,000 cycles. Friction experiments and tensile tests have indicated that sputtered films have a strong adherence to metal surfaces. Electron transmission, diffraction and scanning electron microscopy show that these films have an extremely small particle size less than 30 A in diameter and a very dense and free from observable pinholes. The high kinetic energy of these sputtered species, the submicroscopic particle size and the sputter etched substrate surface is responsible for strong adhesion and cohesion of the sputtered film. Author

N71-25528# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
DESIGN AND CONSTRUCTION OF A PROGRAMMER FOR AN ELECTRON BEAM WELDING MACHINE [ETUDE ET REALISATION D'UN PROGRAMMATEUR POUR UNE SOUDEUSE PAR FAISCEAU D'ELECTRONS]
P. Herzberger 1970 44 p
(EUR-4537-F) Avail: AEC Depository Libraries

A programmer for the control and automatization of the welding processes for an electron beam welder is described. The linear velocity of the cylindric samples to be welded is measured. Digital indications of the welding parameters are also obtained. Author

N71-25538*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CRITICAL SPEEDS OF A ROTOR IN RIGIDLY MOUNTED, EXTERNALLY PRESSURIZED, AIR-LUBRICATED BEARINGS
Robert E. Cunningham and Edward J. Gunter, Jr. Washington May 1971 28 p refs
(NASA-TN-D-6350; E-6134) Avail: NTIS CSCL 13I

Results of experiments conducted with rotors at speeds to 28,000 rpm indicate that rotor critical speeds for a two-bearing rotor system can be calculated quite accurately from rigid-body theory using the film stiffness as determined from zero-speed, load-eccentricity data. Results of a flexible rotor analysis show that accurate critical-speed predictions are possible even for the conical mode, when the bearing forces are assumed to act in a single plane. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N71-24428# Raytheon Co., Waltham, Mass. Research Div.
CZOCHRALSKI GROWN LASER MATERIALS Final Report, 15 Jan. – 15 Oct. 1970
Marvin J. Weber, Michael Bass, Roca R. Monchamp, and E. Comperchio Wright-Patterson AFB, Ohio AFML Dec. 1970 117 p refs
(Contract F33615-70-C-1289)
(AD-718980; S-1263; AFML-TR-70-258) Avail: NTIS CSCL 20/5

Yttrium orthoaluminate is investigated for use as an optically-pumped laser host material. The material was grown using the Czochralski method; growth characteristics and parameters are described. A survey and measurements of various crystallographic, mechanical, thermal, and optical properties of YA1O3 crystals are presented. Laser ion systems studied included Nd3+, Nd3+ sensitized by Cr3+, and Ho3+ sensitized by Er3+, and Tm3+. Measurements were made of absorption, fluorescence, and excitation spectra, absorption and emission cross sections, excited-state lifetimes, and energy transfer processes. Laser performance data are presented for pulsed, Q-switched, and CW operation of Nd3+:YA1O3 at 1.06 - 1.08 micrometers and pulsed operation of Ho3+:YA1O3 at 2.12 micrometers. Author (GRA)

N71-24440# Army Tank-Automotive Command, Warren, Mich.
INVESTIGATION OF A LASER ILLUMINATOR THERMAL IMAGING SYSTEM FOR THE DETECTION OF VOIDS AND DISBONDS
Otto Renius Jan. 1971 29 p refs
(AD-719241; TACOM-TR-11169) Avail: NTIS CSCL 13/8

An infrared nondestructive testing technique employing laser heating of the specimen was developed and evaluated on several bonded materials. Thermal images were obtained using a two-dimensional reflective scanner coupled to a 30-watt CO2 laser to irradiate the specimen and a thermal imaging camera to view the specimens irradiated surface. The technique is capable of providing a versatile, high-resolution, real-time non-destructive test for subsurface defects in large specimens. Author (GRA)

N71-24462# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphaere.
BACKSCATTER STUDIES IN FOG USING LASER TECHNIQUE [UNTERSUCHUNG DER RUECKSTRAHLUNGSBEDINGUNGEN IM NEBEL MITTELS LASER-VERFAHREN]
Horst S. Helbig Nov. 1970 39 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-31) Avail: NTIS; ZLDI Munich: 10.10 DM

Optical backscatter by fog is theoretically investigated and compared with experimental data obtained by a laser device. The laser device serves as an optical probe enabling remote determination of fog characteristics and ranging of targets hidden in fog. Under certain conditions is is possible to detect targets invisible to the naked eye. The measuring range is quantitatively estimated in relation to the visual range in fog. The measuring device can be adapted to varying conditions. Proposals are made for further development. Author (ESRO)

N71-24641*# Techtran Corp., Glen Burnie, Md.
LASERS AND THERMONUCLEAR REACTIONS [LAZER RAZOGREVAYET PLAZMU]
P. G. Kryukov Washington NASA May 1971 5 p ref Transl. into ENGLISH from Priroda (Moscow), v. 7, Jul. 1969 p 61 – 63

(Contract NASw-2037)
(NASA-TT-F-13662) Avail: NTIS CSCL 20E

An experimental design is presented in which a plasma is heated by ultrashort laser radiation for fast neutron observation. A single pulse from a train of ultrashort pulses was used to trigger a Kerr cell and produce laser radiation, which in turn heated a lithium deuteride target to generate a high temperature plasma. It is concluded that a powerful laser can be used to heat a plasma to temperatures at which thermonuclear reactions begin. Calculations indicated that the average energy for a plasma particle reached 2000 eV, corresponding to 20 million degrees. Author

N71-24731# Hughes Research Labs., Malibu, Calif.
IMPACT IONIZATION PUMPED LASER IN POLAR SEMICONDUCTOR Final Report, 1 Jan.-31 Dec. 1970
Donald F. DuBois Jan. 1971 106 p refs
(Contract N00019-70-C-0285)
(AD-719403) Avail: NTIS CSCL 20/5

A review is presented of a theoretical study to determine the feasibility of achieving bulk laser action in polar semiconductors, pumped by impact ionization in an applied electric field. The material of particular interest in view of past experiments is CdTe. A detailed theory of the population inversion as a function of applied field has been carried out. Novel methods have been developed to solve the Boltzmann transport equation in the high field case with polar optic phonon scattering. Upper bounds on the electron-hole generation rates as functions of the applied fields for polar semiconductors have been calculated and show reasonable agreement with the limited available experimental data. On the basis of idealized models, it is concluded that in CdTe the electron and hole distributions can be made sufficiently degenerate for laser action for applied fields in the range of about 1.1 to 2 times the threshold field for current breakdown. Author (GRA)

N71-24732# United Aircraft Corp., East Hartford, Conn. Research Labs.
RESEARCH INVESTIGATION OF PICOSECOND LASER PULSES Semiannual Report, 1 Aug. 1970-31 Jan. 1971
Anthony J. DeMaria, William H. Glenn, George L. Lamb, Jr., Michael E. Mack, and Brian E. Treacy 25 Feb. 1971 76 p refs
(Contract N00014-66-C-0344; ARPA Order-306-23)
(AD-719415; UACRL-K920479-27) Avail: NTIS CSCL 20/5

The report discusses work under the contract for the period 1 August 1970 to 31 January 1971. Topics discussed include theoretical and experimental work on dynamic spectroscopy of ultrashort light pulses, stimulated scattering effects, nonlinear propagation, organic dye lasers, and flashlamps for organic dye lasers. Author (GRA)

N71-24828* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LASER FLUID VELOCITY DETECTOR Patent
Fred H. Shigemoto, inventor (to NASA) Issued 15 Dec. 1970 (Filed 15 Dec. 1967) 6 p Cl. 356-28; Int. Cl. G01c3/08
(NASA-Case-XAC-10770-1; US-Patent-3,547,540; US-Patent-Appl-SN-690997) Avail: US Patent Office CSCL 20E

A method and apparatus for measuring the velocity of a moving fluid, including a laser or like source of a beam of coherent electromagnetic radiation to illuminate particulate matter in the moving fluid is reported. Light scattered in the flow is collected at two points located at different viewing angles and is superimposed at the surface of a photodetector. The frequency of the scattered light is Doppler shifted from that of the laser beam as a result of the movement of the fluid and, since the scattered light is viewed at different viewing angles, the Doppler shift is different for the two light collectors. An indication of the difference frequency is obtained by feeding the output from the photodetector to a frequency detector such as a spectrum analyzer, oscilloscope, or the like, which may be calibrated in terms of velocity. Official Gazette of the U.S. Patent Office

N71-24829 Maryland Univ., College Park.
AN EXPERIMENTAL STUDY OF LARGE HELIUM-NEON RING LASER
Richard Henry Pohle (Ph.D. Thesis) 1969 230 p
Avail: Univ. Microfilms Order No. 70-10296

The output of a square, 20 meter perimeter, RF excited He-Ne ring laser was studied under various conditions of lasing gas pressure, cavity tuning, excitation, and magnetic field applied to the laser medium. The laser mode spectrum, (using a He-Ne scan laser as a heterodyne spectrometer) and the simultaneous intensity fluctuations (from dc up to nanosecond pulses) of both traveling wave beams (TWB) were studied. The beat from the Earth's rotation between the oppositely directed TWB was observed and found to be about 365 Hz as expected at this latitude. The exact beat frequency could vary from 10 to 50 Hz around 365 Hz depending on the laser environment and parameters. Dissert. Abstr.

N71-24831* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HIGH-GAIN, BROADBAND TRAVELING WAVE MASER Patent
Robert C. Clauss, inventor (to NASA) Issued 23 Dec. 1969 (Filed 12 Nov. 1968) 8 p Cl. 330-4; Int. Cl. H01s1/00 Sponsored by NASA
(NASA-Case-NPO-10548; US-Patent-3,486,123; US-Patent-Appl-SN-775072) Avail: US Patent Office CSCL 20E

A high gain, broadband traveling wave maser of the folded comb type is provided by a structure which increases gain by: a unitary or integral comb and wave guide structure; adjustable signal coupling loops; use of single crystal yttrium iron garnet isolators supported by active material of the same type and quality as the maser material; use of zero-degree Czochralski ruby as the active material; improved means for clamping active material in the comb and waveguide structure; and a comb shape design which optimizes the phase filling factor. Stagger tuning of sections of the folded traveling wave maser is achieved by iron shims and conductive coils to selectively modify the external magnetic field for the desired band width. Official Gazette of the U.S. Patent Office

N71-24832* National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
REPETITIVELY PULSED, WAVELENGTH SELECTIVE LASER Patent
Philip L. Hanst, inventor (to NASA) Issued 22 Dec. 1970 (Filed 20 Feb. 1969) 6 p Cl. 331-94.5; Int. Cl. H01s3/00
(NASA-Case-ERC-10178; US-Patent-3,550,034; US-Patent-Appl-SN-800973) Avail: US Patent Office CSCL 20E

A laser with two gas absorption cells built into the laser cavity is described. The first of these cells contains a gas which controls the wavelength of emission and the second contains a gas which forces the laser into a high frequency pulsed mode of operation. Alternatively, a single gas absorption cell is used, the pulsing and wavelength shifting gases are mixed prior to insertion into the cell and the mixture is then heated to induce pulsing. Official Gazette of the U.S. Patent Office

N71-24837 Stanford Univ., Calif.
LASER POWER STABILIZATION BY NONLINEAR ABSORPTION
Janusz Warszawski (Ph.D. Thesis) 1969 94 p
Avail: Univ. Microfilms Order No. 70-10545

Theoretical and experimental investigations of the power stabilization of pulsed lasers by means of an automatic negative feedback between the resonator's Q and the energy density are reported. Feedback is provided by an induced nonlinear absorption at the laser frequency. The nonlinear absorption is accomplished by placing within the laser resonator a material exhibiting the stimulated Rayleigh wing scattering. This scattering results in small frequency shifts in comparison to the laser gain linewidth. The advantage of the small frequency shift is that the laser medium gain lowers the power required to reach the threshold for the nonlinear

scattering. For laser power densities well above this threshold, the rise time of the Stokes light is much less than the width of the laser spike. This implies a steady state condition in which the Stokes energy is proportional to the laser energy. Dissert. Abstr.

N71-25096 Cornell Univ., Ithaca, N.Y.
SPONTANEOUS OPTICAL PARAMETRIC SCATTERING
Thomas Gaetano Giallorenzi (Ph.D. Thesis) 1969 87 p
Avail: Univ. Microfilms Order No. 70-8669

Using the quantum mechanical scattering approach, the signal intensity was calculated for the spontaneous parametric process. Three cases are presented: the first deals with normal parametric scattering, i.e., the case where there is no absorption at any of the three frequencies involved in the process; the second deals with the effects of idler absorption on signal intensity in situations where there is negligible Raman scattering; the third deals with the effects on signal intensity in the case where the idler wave is absorbed and there is simultaneous Raman scattering. Experimental results are presented which verify the theoretically predicted signal intensity for the case where there is no idler absorption and for the case where there is idler absorption but negligible Raman scattering. Efforts to construct an internal parametric oscillator are described. Dissert. Abstr.

N71-25116# Lockheed Missiles and Space Co., Sunnyvale, Calif.
STATE OF THE ART AND PROSPECTS OF THE DEVELOPMENT OF HOLOGRAPHY
A. L. Mikaelian [1971] 14 p refs Transl. into ENGLISH from Radiotekh. (Moscow), v. 25, no. 10, 1970 p 3–12
(AD-719855) Avail: NTIS CSCL 14/5

The report reviews the history of holography and the photographic techniques involved. Applications are given. GRA

N71-25231# Georgetown Univ., Washington, D.C.
SELF-CONSISTENT THRESHOLD CALCULATIONS FOR THE SUPERCONDUCTING INJECTION LASER
J. Bostock, W. D. Gregory, L. Leopold, and W. N. Mathews, Jr. Sep 1970 247 p refs Sponsored by AEC
(ORO-3665-24) Avail: NTIS

The basic physical picture of the superconducting injection laser and the results of a temperature-dependent threshold current density calculation for tantalum are reviewed. A self-consistent procedure for determining the threshold conditions for lasing was devised and is explained. To apply this procedure to real materials, a method of determining the effective interaction parameter of a superconductor (which is used to obtain the value of the energy gap) was developed. Calculation results for the interaction parameter and the self-consistent lasing conditions are presented for tantalum, aluminum, vanadium, and lead. Parameter-type calculations, which determine the effects of large current injection on the magnitude of the energy gap, are carried out for the above materials in both the weak- and strong-injection limits (depairing due to excessive drift velocities and depairing due to both drift velocity and overpopulation of quasi-particle levels, respectively). Author (NSA)

N71-25318*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LASER PROPAGATION THROUGH ATMOSPHERIC TURBULENCE
Michael W. Fitzmaurice *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 263–268 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 20E

Turbulence effects on laser propagation through the earth's atmosphere are studied in order to verify theoretical laser communication predictions based on beam amplification and phase fluctuation characteristics. Optical horizontal performance test data on parallel aligned He-Ne and CO2 laser beams over a 1.2 km folded path underwent statistical analyses for amplitude fluctuations; obtained data cover both strong and weak atmospheric turbulance conditions. Evaluated results show that theoretical calculations and measurements agree and that the probability density function of the data is log-normal for both wavelengths. G.G.

N71-25319*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MICRON 10.6 LASER STABILIZATION
William E. Richards *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 269–271 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 20E

Radiofrequency and molecular emission profile reference techniques obtained the following 10.6 micron CO2 laser stabilization characteristics: (1) absolute frequency stability of 3 parts in 10 to the ninth power; (2) heterodyne frequency beat stability of 3 parts in 10 to the 10th power; (3) use of a second order phase-lock loop tracking filter as optical analytical tool; (4) importance of pressure effects and gravity effects on laser stability; and (5) verification of dn/dT frequency control (CO2, solid state frequency references). G.G.

N71-25336*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PULSE LASER RANGING DEVELOPMENT
Thomas S. Johnson *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 327–330 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 20E

Techniques and instrumentation to improve the accuracy, reliability, and operational efficiency of laser ranging systems resulted in modular ruby laser head and a lunar laser ranging receiver-detector system for Apollo 11. The system is capable of a 10-J pulse every 3 seconds and includes beam correcting and coupling optics, boresight capability, and a ranging and data control system. Reflector range measurements from the lunar surface derived during a period of one and one-half hours are analyzed by subtraction from the predicted range ephemeris and residuals are corrected for parallax and other errors. Corrected data are displayed in a histogram with 100-nsec intervals over the range −5 to +5 microseconds with respect to the corrected line. G.G.

N71-25337*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
WIDEBAND LOW NOISE MASER AMPLIFIERS
Wayne E. Hughes *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 337–339 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 20E

Design and development of a 500 MHz bandwidth maser preamplifier are reported, and it is shown that broadband does exist in iron-doped rutile. The feasibility of this type of maser is demonstrated on a multimode cavity in which several frequencies resonate simultaneously. In this configuration, iron-doped rutile maser operation at frequencies separated by 165 MHz at X-band are obtained. It is concluded that maser preamplifier bandwidths of 500 MHz are not unreasonable. G.G.

N71-25338*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GSFC FIELD OPERABLE ATOMIC HYDROGEN STANDARD RESEARCH AND DEVELOPMENT
Harry E. Peters *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 340–343 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 20E

Prototype hydrogen maser standards are described that exhibit an extremely high oscillating line Q because of an exceptionally

large bulb design. Improved temperature and cavity controls in beam optics and source design produced greatly improved hydrogen economy and self containment stability. Test data on new hydrogen maser equipments as automatic cavity tuners, receivers and synthesizers, clocks, power supplies, standard output frequencies and time signals, and monitoring and alarm clocks meet or exceed design goals in terms of stability, accuracy, and reproducibility. G.G.

N71-25571*# Alabama Univ., University. Bureau of Engineering Research.
STUDY OF THE EFFECTS OF ATMOSPHERIC TURBULENCE ON LASER COMMUNICATIONS SYSTEMS, VOLUME 1
Interim Report
William E. Webb Mar. 1971 43 p refs
(Contract NAS8-25562)
(NASA-CR-103112; BER-130-70-Pt-1) Avail: NTIS CSCL 20E

The research project to determine the effects of atmospheric turbulence on the propagation of a 10.6 micron laser beam is discussed. Analyses of the effects of the aircraft navigational errors on experimental accuracy are presented. Experimental and theoretical investigations of the operation of a carbon dioxide laser heterodyne communications system are described. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N71-24352# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRODEPOSITED FILMS OF IRON-NICKEL-MOLYBDENUM TERNARY ALLOYS
L. F. Ilyushenko et al 30 Nov. 1970 10 p refs Transl. into ENGLISH from Nestsi Akad. Navuk Belarusk. SSR: Ser. Fiz.-Mat. Navuk (Minsk), no. 6, 1969 p 121-124
(AD-719811; FTD-HT-23-722-70) Avail: NTIS CSCL 13/6

In the iron-nickel-molybdenum system of alloys there is a region of compositions characterized by high values of magnetic permeability and low coercive force. Of great interest are the alloys in this system possessing uniaxial magnetic permeability, a rectangular hysteresis loop, as well as alloys with high specific resistance. Such alloys can serve as the base for magnetic films used in computer technology and shf engineering. Most works on the properties of films of the ternary system Fe-Ni-Mo are devoted to films made by vacuum evaporation; there are very few studies on electrodeposited films of this system. This is explained by the insufficient development of a method of electrolytic deposition of films, as well as the difficulties involved in using this method with alloys containing molybdenum. Given references are devoted to the study of the electrodeposition of molybdenum with metals of the iron group. The process of electrolytic deposition of such alloys and their properties depend greatly on the mode of deposition - the cathodic density of the current, the acidity and temperature of the electrolyte. However, because of the lack of information on the character of this relationship, the mode of electrodeposition for the given system is generally selected experimentally. Author (GRA)

N71-24378*# Boeing Co., Seattle, Wash. Aerospace Group.
CRACK GROWTH OF 5Al-2.5Sn TITANIUM IN HYDROGEN
W. D. Bixler and W. L. Engstrom Mar. 1971 88 p refs
(Contract NAS9-11435)
(NASA-CR-114859) Avail: NTIS CSCL 11F

Fracture and subcritical flaw growth characteristics were experimentally determined for 5A1-2.5Sn titanium in an environment of low pressure, high purity gaseous hydrogen. The actual material tested consisted of forging parent metal and electron beam welded forging and plate which were tested in the weld heat affected zone and weld centerline, respectively. Static fracture, sustained-load and cyclic load tests were conducted using precracked surface flawed specimens. Specimens with simulated lack-of-penetration weld defects were used to investigate the effects of very long, deep flaws. Specimen thicknesses, welding procedures and environments were selected to simulate those of the Apollo Service Module/Electrical Power System (SM/EPS) cryo-hydrogen tank. For this tank, the failure mode was found to be leakage at proof and operating stress levels. Environmentally induced flaw growth was observed at stresses exceeding the proof stress during nondestructive inspection, no flaw growth would be expected when loaded to the maximum design operating stress for flaw depths up to approximately 90 percent of the thickness. Time dependent growth was observed for flaws that were very long. In addition, cyclic flaw growth rates at stress levels and stress ratios applicable to the SM/EPS cryo-hydrogen tank are essentially zero. Author

N71-24407# Army Foreign Science and Technology Center, Charlottesville, Va.
TITANIUM ALLOYS FOR NEW TECHNOLOGY [TITANOVYE SPLAVY DLYA NOVOI TEKNIKI]
A. A. Baikova 19 Feb. 1970 104 p refs Transl. into ENGLISH from the Russian
(AD-719487; FSTC-HT-23-581-69) Avail: NTIS CSCL 11/6

The collection includes subject matter of the scientific and technical conference on metallurgy, metal sciences, an application of titanium and its alloys, which took place in July of 1966. The following problems are reviewed: interaction of titanium with various elements of the periodic system (general problems of the metallurgic chemistry of titanium); phase transformations in experimental and series-produced titanium alloys; the influence of new metal working methods (thermomechanical forming, high temperature thermo-mechanical forming, etc.) of titanium alloys on changes of physical and mechanical characteristics. This includes welding and soldering of alloys and investigations involving the study of oxidizability and gas saturation for a series of titanium-based alloys of practical significance. Phase diagrams of titanium with a number of elements were generalized and suitable recommendations are made for the selection of alloying additives to produce titanium alloys having specific mechanical and physical properties; new investigations are reported for a number of concrete metal systems such as Ti-Al-Mo-Zr; Ti-Al-V; Ti-Zr-Al. Author (GRA)

N71-24428# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Festkoerper- und Neutronenphysik.
LATTICE PARAMETER MEASUREMENTS ON ALUMINUM AFTER ELECTRON IRRADIATION AT LOW TEMPERATURES
Hans Wagner Jun. 1970 58 p refs In GERMAN
(JUL-664-FN) Avail: AEC Depository Libraries

The lattice parameter and the electrical resistance were measured simultaneously in high purity Al after irradiation with 3 MeV electrons. Liquid helium flowed around the samples during the irradiation and during the measurement. At the conclusion of all four irradiations the samples were isochronously recovered. The recovery of the lattice parameter corresponds well with the resistance recovery. The ratio is constant for all recovery stages and equals the value in the irradiation. It was concluded that the specific resistance of the defects does not depend on the configuration. Interstitial atom agglomerates contribute to the resistance just as do the corresponding interstitial atoms when they are present individually in the lattice. The saturation behavior of Al was also studied. At higher concentration a linear decrease of the damage rate was measured. Author (NSA)

N71-24497# National Physical Lab., Teddington (England). Div. of Chemical Standards

AN ORIGINAL METHOD FOR THE DETERMINATION OF PHASE DIAGRAMS IN MULTI-COMPONENT MIXTURES USING A DIGITAL COMPUTER

J. F. Counsell, E. B. Lees, and P. J. Spencer Dec. 1970 17 p refs

(NPL-DCS-9) Copyright. Avail: NTIS

The mechanical properties of an alloy are dependent upon the amounts and compositions of the phases present and thus phase diagrams are of great importance to the practical metallurgist. Direct experimental determination of phase diagrams particularly at low temperatures, where equilibrium is established slowly, can be a difficult and sometimes inaccurate procedure. However, thermodynamic values, measured at higher temperatures, can be used to calculate phase boundaries over wide ranges of temperature. A new method whereby such calculations are simplified, particularly for multicomponent systems, is described. The method can also be applied to the correlation of thermodynamic data and experimentally determined phase boundaries. Author (ESRO)

N71-24554# Aerospace Corp., El Segundo, Calif.

DIRECTIONAL SOLIDIFICATION OF AN OFF EUTECTIC ALUMINUM-BERYLLIUM ALLOY Technical Report, Jan. 1967 - Sep. 1970

R. T. Pepper and W. R. Wilcox 5 Feb. 1971 30 p refs Prepared in cooperation with Univ. of Southern Calif., Los Angeles

(Contract F04701-70-C-0059; Grant AF-AFOSR-1622-69)

(AD-718964; TR-0059(9250-03)-2; SAMSO-TR-71-29) Avail: NTIS CSCL 11/6

Aligned fibers of beryllium in aluminum were obtained by zone melting of an aluminum 20 wt % Beryllium alloy. Unfortunately, the fiber length was limited by periodic banding caused by freezing rate fluctuations. Thus, the ultimate strength was only about 11,000 psi and the elastic modulus 15,000,000 psi. Analytical expressions were found for the concentration perturbation caused by changes in freezing rate, both for progressive freezing with no convection and for zone melting with considerable liquid mixing. Author (GRA)

N71-24562# Army Foreign Science and Technology Center, Washington, D.C.

EFFECT OF ADDITIONAL ALLOYING ON MECHANICAL PROPERTIES OF Al-Zn-Mg-Li ALLOY [VLIYANNE DONALNITELNOGO LEGIROVANIYA NA MEKHANNCHESKNE SVOISTVA SNLAVA AL-ZN-MG-LI]

E. S. Kadaner et al 17 Feb. 1970 13 p refs Transl. into ENGLISH from Russian report

(AD-719478; FSTC-HT-23-238-70) Avail: NTIS CSCL 11/6

The effect of alloying additives such as manganese, chromium and zirconium, on the strength properties of A1-Zn-Mg-Li alloys is investigated. Alloys containing lithium as an additive have higher strength properties than alloys not containing lithium. The advantage of A1-Zn-Mg alloy containing lithium is that a high level of strength is achieved at high aging temperaturres. This makes it possible to increase the resistance of the material to corrosion destruction and is useful from the point of view of preventing internal stresses that arise during hardening and welding. Author (GRA)

N71-24563# Washington State Univ., Pullman. Dept. of Physics.

EQUATION OF STATE OF THE ALPHA AND EPSILON PHASES OF IRON

Dudley J. Andrews (Ph.D. Thesis) Jan. 1971 144 p refs

(Contract DA-04-200-AMC-1702/X/)

(AD-719233; WSU-SDL-70-05; BRL-CR-23) Avail: NTIS CSCL 11/6

An empirical equation of state that is thermodynamically consistent is found for the alpha (body-centered-cubic) and epsilon (hexagonal-close-packed) phases of iron. A functional form of the Helmholtz potential is formulated from general considerations of lattice vibrations, conduction electrons, and ferromagnetic exchange interaction. The Helmholtz potential is adjusted to get a fit to calorimetric, thermal expansion, acoustic, static compression, and shock data. The Gibbs potential corresponding to this fit is used to describe the alpha-epsilon phase transition. Numerical calculational procedures are developed for mixed phases in equilibrium and for time-dependent transformation. Author (GRA)

N71-24733# United Kingdom Atomic Energy Authority, Springfields (England).

THE MATRIX PRECIPITATION OF NbC IN 20/50/Nb STAINLESS STEEL

A. F. Rowcliffe and J. Winton 1 Jun. 1970 12 p refs Sponsored by AEC

(TRG-Report-2040(S)) Avail: AEC Depository Libraries

A series of heat treatments carried out on a 20/25/Nb stainless steel are described, the aim of which was to define the conditions necessary to attain a fine homogeneous dispersion of NbC. Solution heat-treatment temperatures above 1200 C are essential to attain sufficient solute supersaturation, and the most consistent results are subsequently obtained by quenching direct to an aging temperature of about 700 C. If the material is cooled to room temperature before aging, the cooling rate for successful precipitation is very critical. The correct heat treatment conditions would not be easily attained in commercial practice. Author (NSA)

N71-24734# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.

CORROSION IN HIGH TEMPERATURE LITHIUM HEAT PIPES WITH NIOBIUM-ZIRCONIUM AND TANTALUM AS WALL MATERIAL [KORROSION IN HOCHTEMPERATUR-LITHIUM-WAERMEROHREN MIT NIOB-IZIRKON ODER TANTAL ALS WANDMATERIAL]

C. A. Busse 1969 32 p refs Submitted for publication

(EUR-4298-e) Avail: AEC Depository Libraries

In Nb-1 Zr or Ta heat pipes with Li as working fluid, operated at temperatures of 1500 or 1600 C, corrosion can cause a wall perforation in the heating zone within a few hours. Analysis of such heat pipes, together with fluiddynamic and thermodynamic considerations, leads to the conclusion that the corrosion is caused by the initial oxygen content of the wall material. The corrosion mechanism consists in the transition of oxygen from the wall material of the cooling zone to the liquid Li, the transport of the oxygen to the heating zone, the local increase of the oxygen concentration in the liquid Li by the evaporation process and finally the wall attack by this oxygen-rich Li. The corrosion can be strongly reduced or completely inhibited by deoxidation of the wall material, by the addition of Ca to the Li, or of Y to the Ta. Author (NSA)

N71-24818# Eidgenoessisches Institut fuer Reaktorforschung, Wurenlingen (Switzerland).

CORROSION OF ZIRCONIUM ALLOYS IN SUPERHEATED STEAM: RESULTS OF THE PROLONGED EXPERIMENTS [KORROSION VON ZIRKONIUMLEGIERANGEN IN UEBERHITZTEM DAMPF: ERGEBNISSE DER LANGZEITVERSUCHE]

A. Gruetter Jul. 1970 63 p refs In GERMAN

(EIR-184) Avail: AEC Depository Libraries

The corrosion behavior of seven alloys (Ozhennite, Zr - 1.5 Nb, Zr - Cu - Fe, Zr - Cr - Si, Zircaloy-2, and Zr - 2.5 Nb) was investigated in steam at 50 atm and 350 and 450 C over a prolonged period. The behavior both at 350 and 450 C varies sharply among the alloys. With the exception of Zr - 1.5 Nb, an exponent of about 3 at 350 C and about 2.5 at 450 C was established for all the alloys in the pretransition range. The alloys vary greatly with respect to the transition point data. The time up to the transition point, for example, varies at both temperatures

from several days (Zr–Cr) to over 750 days (Zr–Cu–Fe). The phenomenon of transition is connected with a cloud formation observed under the microscope and it is very probably conditional on hollow formation in or under the oxide layer. The appearance of the transition cannot be correlated with the formation of microscopically observable fissures perpendicular to the surface.
Author (NSA)

N71-24819# European Atomic Energy Community, Ispra (Italy).
SPECTROCHEMICAL ANALYSIS OF Zr AND ITS ALLOYS. 1: DETERMINATION OF ORDINARY IMPURITIES AND OF Ta IN Zr AND IN ZIRCALOY-2 [L'ANALYSE SPECTROCHIMIQUE DU ZIRCONIUM ET SES ALLIAGES. 1: DETERMINATION DES IMPURETES COURANTES ET DU TANTALE DANS LE ZIRCONIUM ET DANS LE ZIRCALOY-2]
G. Ceccarelli and G. Rossi 1970 36 p refs In FRENCH
(EUR-4541-f) Avail: AEC Depository Libraries

Spectrochemical methods for the determination of metal impurities in zirconium and Zircaloy-2 are presented. The carrier distillation technique of Scribner and Mullin has been successfully applied with proper modifications to the determination of Al, B, Be, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Si, Sn, and V in zirconium and of Al, B, Be, Cd, Co, Cu, Mn, Mo, Ti, and V in Zircaloy-2, In2O3 being used as carrier. Moreover, the use of a variable internal standard (Fe) in the case of Zircaloy-2 allowed a higher precision to be obtained. The methods for the determination of low Ta contents in the above-cited materials are also described. These methods are based on a fluorination procedure with teflon powder and dc arc excitation. The lowest Ta concentration (25 ppM) that can be measured does not represent the detection limit of the procedure described but compares favorably with the best sensitivity values in the literature. Author (NSA)

N71-24827# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Fuel Engineering Branch.
THE EFFECT OF IRRADIATION ON THE TENSILE AND IMPACT PROPERTIES OF 3 1/2 PERCENT AND 9 PERCENT NICKEL STEEL WELDMENTS
M. B. Watson and B. L. Wotton Oct. 1970 33 p refs
(AECL-3734) Avail: AEC Depository Libraries; Atomic Energy of Can., Ltd., Chalk River: $0.50

The effects of fast neutron irradiation at temperatures below 140 C on the tensile and impact properties of 3-1/2% nickel steel and 9% nickel steel weldments were studied. Results indicated that saturation of fast neutron damage occurs in the 3-1/2% nickel steel by a neutron fluence of 9.3 × 10 to the 19th power n/sq cm > 1 MeV. At this level the change in the 0.2% yield strength was about 120%, and the increase in transition temperature about 280 C. Only the tensile properties of the 9% nickel steel are near saturation at this fluence. The change in the 0.2% yield strength was about 60% and the increase in transition temperature about 170 C. The latter value could be increased by a prolonged post-weld heat treatment. Significant variations in impact properties were observed for different forms of steel of the same nominal compositions. Author (NSA)

N71-24830* General Dynamics/Astronautics, San Diego, Calif.
PLATING NICKEL ON ALUMINUM CASTINGS Patent
Bernard J. Brinks, inventor (to NASA) Issued 14 Oct. 1969 (Filed 15 Mar. 1966) 4 p Cl. 204-38; Int. Cl. C23b5/50; 17/00, 5/08 Sponsored by NASA
(NASA-Case-XNP-04148; US-Patent-3,472,742; US-Patent-Appl-SN-536210) Avail: US Patent Office CSCL 11F

A process of nickel plating aluminum is described which comprises etching the aluminum, applying an alkali metal silicate to the etched aluminum surface to fill irregularities, and baking this silicate onto the aluminum surface. The aluminum is then treated with a hot electroless nickel plating solution, exposed to an acidic bath to remove residual particles, and treated with a relatively warm electrolytic nickel plating solution to electrodeposit nickel thereon and fill all surface irregularities.
Official Gazette of the U.S. Patent Office

N71-24871# California Univ., Berkeley. Lawrence Radiation Lab. Inorganic Materials Div.
ELECTRON MICROSCOPY OF SPINODAL ALLOYS
R. J. Livak and G. Thomas Jun. 1970 7 p refs Presented at the 28th Meeting of Electron Microscopy Soc. of Am., Houston, Tex., 5–9 Oct. 1970
(Contract W-7405-eng-48)
(UCRL-19629; CONF-701003-5) Avail: NTIS

The microstructure of spinodal copper–iron–nickel alloys was studied by electron microscopy. Microstructural changes during aging were correlated with changes in yield stress and fracture mode of the aged specimens. NSA

N71-24872# Centre National de la Recherche Scientifique, Villeurbanne (France). Inst. de Recherche sur la Catalyse.
CONTRIBUTION TO THE STUDY OF THE MECHANISM OF OXIDATION OF PURE OR ALLOYED ZIRCONIUM BY OXYGEN AND STEAM [CONTRIBUTION A L'ETUDE DU MECANISME D'OXYDATION DU ZIRCONIUM PUR OU ALLIE PAR L'OXYGENE ET LA VAPEUR D'EAU]
M. Leclercq 1970 174 p refs In FRENCH Sponsored in part by Euratom
(EUR-4507-f) Avail: AEC Depository Libraries

Results of a microgravimetry and metallography study of the oxidation of zirconium and Zircaloy-2 under oxygen pressures or partial steam pressures of 6, 10, and 16 torr at 600 to 800 C are presented. Results of a study on a zirconium filament under reduced air or oxygen pressure are also presented. Author (NSA)

N71-24873# Comision Nacional de Energia Atomica, Buenos Aires (Argentina).
DETERMINATION OF TRACES OF HAFNIUM IN ALUMINUM-URANIUM ALLOYS [DETERMINACION DE TRAZAS DE HAFNIO EN ALEACIONES ALUMINIO-URANIO]
O. O. Guido, H. Grahmann, C. B. Amaya, and R. Zucal 1970 14 p refs In SPANISH
(CNEA-276) Avail: AEC Depository Libraries

A method was developed for the determination of trace amounts of hafnium in aluminum-uranium alloys. The quantitative determination was carried out by emission spectrography, using a continuous feed method and a porous electrode. The reproducibility was appreciably improved by using titanium as an internal standard. The method makes it possible to determine hafnium in the range from 2 to 20 ppM with a relative standard deviation of 3% (level of confidence of 68%). Author (NSA)

N71-24878# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE DENSITY DISLOCATIONS OF PHASE COMPONENTS IN FRICTION SURFACES OF HIGH STRENGTH CAST IRONS
L. I. Markovskaya et al 3 Dec. 1970 19 p refs Transl. into ENGLISH from the book "Litye Iznosostoikie Materialy" Kiev, Izd-vo Naukova Dumka, 1969 p 34–44
(AD-719793; FTD-MT-24-242-70) Avail: NTIS CSCL 11/6

The changes in dislocation density in surface layers of high strength cast irons with ferritic and pearlitic structure by the action of dry and lubricated friction were studied at various rates and loads for 2-4 hours. Ferritic cast iron before and after dry friction testing for wear had 6 X 10 10 to the 11th power and 2 X 10 10 to the 12th power linear defects/cm sq cm resp. in the alpha-phase. High-strength pearlitic cast-iron had a higher amt. of dislocations after dry friction testing for wear. (5 X 10, 10 to the 12th power,/cm, sq cm. The friction with lubrication had an effect

similar to that of dry friction. The gamma-phase showed a max. dislocation d. 5-10 times that in the alpha-phase, and this d. depended significantly on the slip rate. Lubricated friction resulted in dislocation ds. 2.5-3 times that with dry friction. The dislocation d. produced with friction deformation may reach the value of 3 X 10 to the 13th power/sq cm, which is close to the theoretically possible max. dislocation density. Author (GRA)

N71-24911* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SHOCK TUBE POWDER DISPERSING APPARATUS Patent

Hoyt H. Todd, inventor (to NASA) Issued 14 Oct. 1969 (Filed 27 Dec. 1966) 6 p Cl. 118-308; Int. Cl. B05c5/02; Int. Cl. B65d47/10

(NASA-Case-XLE-04946; US-Patent-3,472,202; US-Patent-Appl-SN-605093) Avail: US Patent Office CSCL 11F

Apparatus for treating metal powders to separate or disperse the powder grains to permit microscopic observation is described. A rupturable supporting cup holds a mass of powder and is broken by a high intensity shock wave generated in a shock tube having an opening toward the supporting cup. A collection means receives and retains the dispersed powder grains from the ruptured cup. Official Gazette of the U.S. Patent Office

N71-24912 Stanford Univ., Calif.

THE INFLUENCE OF COOLING RATE AND YIELD STRENGTH UPON THE MECHANICAL BEHAVIOR OF BRAZED JOINTS

Harry James Saxton (Ph.D. Thesis) 1969 223 p

Avail: Univ. Microfilms Order No. 70-10520

Three specific areas were investigated: (1) the influence of cooling rate from an elevated temperature on the tensile performance of Fe-3%Si joined with Ag-4%Pd, (2) the influence of base metal yield strength on the tensile behavior of joints formed with Ag-4%Pd, and (3) the influence of braze metal yield strength on the tensile performance of drill rod joined with either Ag-4%Pd or lithobraze 925. It is found that specimens furnace cooled from 800 C are consistently stronger than specimens water quenched from 800 C. While the tensile strengths of furnance cooled and water quenched specimens differ by 2500 psi or less for large thickness to diameter (t/d) ratios of the braze, at t/d ratios less than 200, water quenched specimens display catastropic decreases in tensile strength. At large t/d values, the difference in tensile strength is adequately explained by the effects of the residual stress state induced into Fe-Si by quenching. For small t/d values, the difference in tensile strength results from changes induced in the Ag-Pd braze metal by quenching. Dissert. Abstr.

N71-24916 Stanford Univ., Calif.

DEFORMATION ENHANCED DIFFUSION IN METALS AS ASSESSED BY ELEVATED TEMPERATURE CREEP EXPERIMENTS

James Stuart Perrin (Ph.D. Thesis) 1969 98 p

Avail: Univ. Microfilms Order No. 70-10503

The steady state creep behavior of alpha iron (Fe - 0.02% C) was studied in both the power law range and at higher creep rates in the high stress power law breakdown range to use the results of creep experiments to provide additional information about possible mechanisms that could be causing diffusion enhancements. It is shown that creep is controlled by the diffusion coefficient measured in static, undeformed specimens rather than the enhanced diffusion coefficient measured by some investigators in specimens under creep deformation. From the creep experiments, it is concluded that diffusion enhancement in alpha iron in the power law creep range cannot be occurring by generation of large numbers of excess vacancies generated uniformly throughout the lattice. The influence of the paramagnetic-ferromagnetic transformation in iron on the self-diffusion and steady state creep rate was studied through creep experiments on Fe-0.02% C, high purity AISI iron (99.994% Fe), and Fe-3.05% Si. Dissert. Abstr.

N71-24917 Purdue Univ., Lafayette, Ind.

STEADY STATE DIFFUSION IN COPPER-MANGANESE-ZINC ALLOYS

John Daniel Whittenberger (Ph.D. Thesis) 1969 154 p

Avail: Univ. Microfilms Order No. 70-8991

Steady state diffusion in the copper-manganese-zinc substitutional system was investigated with vapor-solid couples to determine the steady state concentration profiles and explore the feasibility of calculating from them atomic mobilities of the diffusing components. Thin membranes of copper separating two selected ternary copper-manganese-zinc alloys were used to set up the vapor-solid diffusion couples. The alloy sources in the form of fine chips supplied manganese and zinc vapors necessary for diffusion into the membrane. Concentration penetration profiles of manganese and zinc were determined by sectioning the diffused membrane and analyzing it with an electron microprobe. Four series of diffusion couples were studied and, in most cases, the steady state profiles were realized within four to six days. Dissert. Abstr.

N71-24921 Utah Univ., Salt Lake City.

DEGASSING OF COPPER WIRES IN AN ULTRAHIGH VACUUM

Larry Elmer Pope (Ph.D. Thesis) 1970 238 p

Avail: Univ. Microfilms Order No. 70-10408

Degassing of commercially available copper products was studied in an ultrahigh vacuum system at temperatures greater than 700 C. Relative quantities of hydrogen, oxygen, carbon, and nitrogen evolved for 9 different copper products during an anneal at 930 C are reported. Qualitatively, the evolved nitrogen originated on the surface, the hydrogen and carbon originated in the bulk, and the oxygen originated both on the surface and in the bulk. Analysis of rates of evolution as a function of time at 930 C showed that diffusion may be controlling only initially. After four minutes heating time a change in controlling mechanism was in process resulting in a new mechanism being established by 12 minutes heating time. A study of rates of evolution as a function of temperature over the range 735 to 945 C determined the activation enthalpies for oxygen, carbon monoxide, carbon dioxide, hydrogen, and water evolution to be 80, 25, 40, 75, and 40 kcal/mole, respectively. Dissert. Abstr.

N71-24932# Iowa State Univ. of Science and Technology, Ames. Rare Earth Information Center.

RARE EARTH METALS IN STEELS

Nancy Kippenhan and Karl A. Gschneidner, Jr. 1 Mar. 1970 61 p refs Sponsored by Molybdenum Corp. of Am.

(IS-RIC-4) Avail: NTIS

The effects of rare-earth additions to steel are discussed. Several general facts about the effect of rare earths on steel and some specific points, which may or may not have general utilization in a particular class or classes of steels are presented. In general the rare earths impart beneficial effects on the steel, but sometimes can have a deleterious effect. The rare earths have a strong influence on sulfur and/or sulfides; the trend is toward sulfur removal and spheroidization of sulfides or oxysulfides. They tend to improve the oxidation and scaling properties of nominally oxidation resistant steels. The rare-earth metals improve the mechanical properties of the steels. In general the room temperature strength and impact properties, the high temperature creep-rupture properties and hot workability are better for rare earth-treated steels than untreated steels. The amount of rare-earths added is critical. Too little and little or no benefit is realized. Too much and they have deleterious effects: increased brittleness, lower strength, and poor high temperature properties. NSA

N71-24936# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE STRENGTH AND PLASTICITY OF REFRACTORY ALLOYS DURING PROGRAMMED VARIATIONS OF TEMPERATURE AND LOAD
V. T. Troshchenko et al 23 Nov. 1970 25 p refs Transl. into ENGLISH from Akad. Nauk Ukr. SSR, Inst. Probl. Prochnosti (Kiev), no. 1969 p 130-141
(AD-719833; FTD-MT-24-251-70) Avail: NTIS CSCL 11/6

Results of an investigation of thermocyclic creep and rupture strength in niobium, tantalum, and molybdenum based refractory alloys under conditions of sharp temperature variations and also under conditions of alternating isothermal and nonisothermal loads during axial tension and compression. Time to failure in these alloys is found to be determined primarily by the time parameters of the loading cycles, while the effects of fatigue on strength are practically insignificant in them. Author (GRA)

N71-24945 Lehigh Univ., Bethelehem, Pa.
IMPURITY EFFECTS IN HIGH STRENGTH STEEL WELD DEPOSITS
Robert Quattrone (Ph.D. Thesis) 1969 134 p
Avail: Univ. Microfilms Order No. 70-10614

The effect of additions of oxygen and hydrogen, alone or in combination, on the strength, toughness and crack susceptibility of weld metals made from 3% Ni and 5% Ni HY 130 type welding wires was studied. High purity vacuum induction heats of welding wire were used and controlled impurity additions were made through the weld shielding gas in an atmosphere chamber. Oxygen effects on strength were complicated by the competitive processes of partial decarburization and dispersed phase strengthening. The loss in strength by decarburization appeared to be the more significant of the two effects. Susceptibility to hydrogen induced cracking was evaluated using the Keyhole slotted plate restraint specimen. GTA welds were found to be more resistant to cracking than GMA welds and 5% Ni welds more resistant than 3% Ni welds. Oxygen addition to the shielding gas of GTA welds further increased the hydrogen crack resistance, however, oxygen addition to the shielding gas of GMA welds made these welds more susceptible to hydrogen cracking. Dissert. Abstr.

N71-25057# Royal Aircraft Establishment, Farnborough (England).
POTENTIOSTATIC POLARIZATION BEHAVIOUR OF HIGH PURITY ALUMINUM IN NEUTRAL SOLUTIONS CONTAINING NO3 (-) or NO2 (-) IONS
Katsuhisa Sugimoto et al Nov. 1970 19 p refs Transl. into ENGLISH from Nippon Kinzoku Gakkaishi (Sendai City), v. 30, 1966 p 1153-1157 Presented at the Japan. Inst. of Metals, Tokyo, Apr. 1966
(RAE-Lib-Trans-1510) Avail: NTIS

The effects of NO3(-) or NO2(-) ions on the potentiostatic polarization of 99.99% Al in neutral aqueous solutions of NaCl were investigated. The results obtained are summarised as follows: (1) Pitting corrosion of aluminum in 0.5 N-NaCl solution is not inhibited completely by the addition of 0.5 N NO3(-) or NO2(-) ions. (2) An abnormal reduction peak is observed on the cathodic polarization curve of 99.99% Al in solutions containing NO3(-) or NO2(-) ions at a potential near -1.2 V (vs. S.C.E.), but no peak is observed on the curves of other pure metals and alloys, such as 99.49% Al, Cu, Fe, Ti, Zn, Pt, Cu-Hg and Zn-Hg. This reduction peak which is characteristic of 99.99% Al in these solutions is due to both the existence of colloidal films on the surface and the greater hydrogen overvoltage of this metal. Author

N71-25063# Army Foreign Science and Technology Center, Charlottesville, Va.
INVESTIGATION OF THE PROPERTIES OF TITANIUM ALLOYS AS FUNCTIONS OF TREATMENT CONDITIONS [ISSLEDOVANIYA SVOISTV TITANOVKH SPLAVOV V ZAVISNMOSTI OT USLOVII OBRABOTKI]
S. G. Glazunov et al 22 Sep. 1970 20 p refs Transl. into ENGLISH from the Russian
(AD-719616; FSTC-HT-23-241-70) Avail: NTIS CSCL 11/6

The results of scientific research and pilot scale work on the fettling of titanium and an estimate of the promise of this method in various aspects of the production technology of titanium semi-finished products are given. Author (GRA)

N71-25076# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MECHANICAL PROPERTIES OF REFRACTORY METALS
A. P. Gulyaev et al 5 Nov. 1970 17 p refs Transl. into ENGLISH from the Russian
(AD-719829; FTD-HT-23-604-70) Avail: NTIS CSCL 11/6

There is interest in studying the mechanical properties of refractory metals as functions of temperature, taking into account such factors as the admixtures content, structural state, and the deformation rate. In this report an attempt is made to generalize the available data on the effect of the temperature and the above-listed factors on the mechanical properties of refractory metals of the VA (V, Nb, and Ta) and VIA (Cr, Mo, and W) groups. A large portion of the experimental data used for this purpose was obtained on specially developed equipment permitting research to be carried out on extension in the -196 to 2600C temperature range and the rate of deformation to be varied in a wide range. Author (GRA)

N71-25077# Royal Aircraft Establishment, Farnborough (England).
CONTRIBUTION TO THE STUDY OF TRANSFORMATIONS OF TA 6V TITANIUM ALLOY UNDER ISOTHERMAL CONDITIONS [CONTRIBUTION A L'ETUDE DES TRANSFORMATIONS DE L'ALLIAGE DE TITANE TA 6V EN CONDITIONS ISOTHERMES]
B. Hockeid et al Dec. 1970 21 p refs Transl. into ENGLISH from Mem. Sci. Rev. Met. (Paris), v. 67, no. 9, 1970 p 583 590
(RAE-Lib-Trans-1549) Avail: NTIS

Tests carried out on samples of TA 6V titanium alloy to explain the changes which take place during welding are described. The transformations of the alloy under isothermal conditions were studied, as were the corresponding structures arising under these conditions. The mechanical properties were determined for a whole range of isothermal conditions, and shown to vary only slightly. The fact that the M sub S point for this alloy is situated at about 780 C was verified. Author

N71-25083# Comision Nacional de Energia Atomica, Buenos Aires (Argentina).
INTERNAL FRICTION IN HEATED VANADIUM AT LOW AIR PRESSURE [FRICCION INTERNA EN VANADIO CALENTADO A BAJA PRESION DE AIRES]
Manuel A. Mondino, Daniel Vassallo, and Marta C. de Achterberg 1970 8 p refs In SPANISH
(CNEA-260) Avail: AEC Depository Libraries

The internal friction of polycrystalline samples of V with different oxygen contents containing microstructures similar to a beta phase with a high concentration of nuclei was studied. These samples were obtained after heating between 10 and 24 hrs at a pressure of 0.05 Hg. The measurements of the internal friction and modulus, made using a torsion pendulum in the temperature range from room temperature to 550 C, showed the complete disappearance of the internal friction maximum corresponding to oxygen and nitrogen. The existence of a new internal friction peak at approximately 390 C with a frequency of 0.72 cps was also observed. Its characteristics were determined. The mechanisms observed could not be explained by any present model. NSA

N71-25097 Rensselaer Polytechnic Inst., Troy, N.Y.
THE EFFECT OF MECHANICAL CONSTRAINTS UPON THE INITIAL STAGES OF SINTERING
Peter Charles Eloff (Ph.D. Thesis) 1969 132 p
Avail: Univ. Microfilms Order No. 70-11317

Sintering experiments with linear, planar, and bulk arrays of uniformly-sized spherical copper particles were performed. The kinetics of neck growth and shrinkage in the different arrays were measured to determine whether or not constraints due to the presence of other particles has an influence on the kinetics. Attempts were also made to artificially constrain two dimensional arrays using a dead weight. Metallographic measurements showed a marked difference in neck growth between the different array types sintered for relatively short periods of time. The observed differences tended to disappear as sintering proceeded. Shrinkage measurements were not as conclusive regarding constraints, but were observed to be much higher than was expected from theory. It was also observed that a large dead weight retarded neck growth in a two dimensional array, whereas lower weights had no effect. It is concluded that a two particle model of the sintering of spheres does not strictly describe initial sintering of loose interconnected arrays of spherical particles. Dissert. Abstr.

N71-25098 Stanford Univ., Calif.
THE ROLE OF STRUCTURE IN NEWTONIAN DEFORMATION OF METALS
Eugene Charles Muehleisen (Ph.D. Thesis) 1969 163 p
Avail: Univ. Microfilms Order No. 70-10493

A discussion is given for the dependence of Newtonian creep upon microstructure and, dislocation mechanisms involved in low stress-high temperature (LS-HT) creep. The structural parameters explored in this work are grain boundaries, surfaces, stacking faults and second phase additions. A series of alloys which allowed a systematic variation of the parameters was examined. The structure was characterized by optical and electron microscopy, X-ray diffraction and topography, and etch pit studies. Diffusion controlled jogged dislocation models adequately describe the observed LS-HT creep behavior of aluminum. Several alloys were creep tested at very high temperatures and low stresses. The results suggest that the Nabarro-Herring theory is not widely applicable to the LS-HT creep deformation of metals and alloys. Dissert. Abstr.

N71-25114 Lehigh Univ., Bethlehem, Pa.
DYNAMIC DEFORMATION BEHAVIOR OF TUNGSTEN CARBIDE-COBALT ALLOYS AT ELEVATED TEMPERATURE
Jeffrey Bratspies (Ph.D. Thesis) 1969 92 p
Avail: Univ. Microfilms Order No. 70-10587

The deformation behavior of tungsten carbide-cobalt alloys was investigated by four-point bend tests at temperatures of 700, 800, and 900 C and strain rates between 0.00018 and 0.039 min sup −1. Three alloys were studied: WC-6% Co with 2.04 micron WC particles, WC-13% Co with 2.59 micron WC particles, and WC-15% Co with 2.22 micron WC particles. The deformation and fracture behavior is consistent with the Ansell-Lenel theory for coarse, non-coherent dispersion strengthened alloys. The 6% Co alloy exhibited essentially brittle behavior up to 900 C, failing in the elastic range or after some microplasticity. Fracture was through the carbide phase. No dependence of fracture stress was found with temperature or strain rate. The behavior of the alloys with higher cobalt content, represented by the 13% and 15% alloys, was markedly different. These alloys displayed ductile behavior within the temperature range tested. Dissert. Abstr.

N71-25134# Army Foreign Science and Technology Center, Charlottesville, Va.
INVESTIGATION OF DEFORMATION IN SHOCK LOADING OF ZINC MONOCRYSTALS [ISSLEDOVANIE OSOBENNOSTEI DEFORMIROVANIYA PRI UDARNOM NAGRUZHENNINA MONOKRISTALLAKH CHINKA]
A. A. Mogilevskii 21 Oct. 1970 17 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (Moscow), v. 28, no. 3, 1969 p 508–517
(AD-719536; FSTC-HT-23-1126-70) Avail: NTIS CSCL 11/6

Anisotropy of zinc monocrystals is used for obtaining information concerning the stress state during stressing of crystalline bodies by means of place shock waves. It is shown that plastic deformation occurs both in the compression wave and during relief. The effect of anisotropy of elastic moduli increases as the pressure in the shock waves increases. A theory is advanced concerning sequential activation of displacements in various systems during deformation. Author (GRA)

N71-25145# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF TEST CONDITIONS ON THE STATE OF THE SURFACE LAYER OF NOZZLE BLADES
T. A. Gordeeva et al 11 Dec. 1970 14 p refs Transl. into ENGLISH from the Russian
(AD-719815; FTD-MT-24-300-70) Avail: NTIS CSCL 21/5

The aluminized layer effectively shields the surface blades of the 1st stage under rigid work conditions for 900 hours. In nonaluminized blades of the 2nd stage, despite the substantially lower work temperature, changes take place in the surface layer, which are connected to the formation of a zone impoverished by allowing elements. The structure and properties of the core for all investigated blades did not change. Author (GRA)

N71-25159# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF MICROCRACKS ON THE BRITTLE FRACTURE OF MILD STEEL
T. Sobepanek 4 Dec. 1970 19 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Mashinostro. (Moscow), no. 10, 1969 p 34–41
(AD-719832; FTD-MT-24-238-70) Avail: NTIS CSCL 11/6

Iron (C 0.044, Mn 0.04, Cr 0.09, O 0.076, and N 0.013 wt. per cent) was subjected to various plastic deformations. Microscopic observations showed that the distribution of microcracks as well as the structure of the metal depended on the history of plastic deformation. Upsetting caused the formation of a much larger amt. of horizontal microcracks (perpendicular to the axis) which caused a loss of strength. It is probable that a metal subjected to plastic deformation and thereafter loaded to brittle fracture had 2 opposing effects acting on it: (1) a hardening effect and (2) the effect of microcracks and intrinsic stresses. The 1st effect depends only on the deformation degree, and does not depend on the form of plastic deformation. However, the 2nd effect depends on deformation degree, form of deformation, as well as on the kind of load applied during the deformation. The macro- and microscopic observations showed that on brittle fracture, the principal factors which affect the resistance of soft steel are the amt. and form of the microcracks and other defects, as well as the orientation of the microcracks and intrinsic stresses. Author (GRA)

N71-25203*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
A STUDY OF LOW VELOCITY IMPACTS INTO THIN SHEET ALUMINUM AND NYLON CLOTH
Robert E. Flaherty Washington May 1971 27 p refs
(NASA-TN-D-6324; MSC-S-238) Avail: NTIS CSCL 11F

Single projectiles were launched at velocities between 0.1 and 0.4 km/sec from a specially designed air gun. The projectiles impacted single and multiple layers of thin-sheet aluminum and nylon cloth to simulate the secondary meteoroid flux in the vicinity of the lunar surface and to define the penetration mechanics of

typical spacecraft structures and space-suit materials. The results of these tests have been compared to existing low-velocity-projectile penetration equations, and configurations have been determined for maximum penetration protection. Author

N71-25214# Dow Chemical Co., Golden, Colo.
REVERSIBLE MARTENSITIC TRANSFORMATIONS BETWEEN TRANSITION PHASES OF URANIUM-BASE NIOBIUM ALLOYS
Ross J. Jackson 23 Dec. 1970 11 p refs
(Contract AT(29-1)-1106)
(RFP-1535) Avail: NTIS

The occurrence and generation of transition phases in uranium-niobium alloys is discussed. The transition phases and unit cell parameters as a function of composition and temperature are presented. Also presented is an approximated transition phase diagram. The highly anisotropic lattice parameter changes of orthorhombic, monoclinic, and tetragonal with temperature and composition are discussed from a crystallographic viewpoint. Inherent in this discussion is the consecutiveness and thermal reversibility of the rhombic, monoclinic, and tetragonal structures; and the thermal reversibility of change in monoclinic cell angle of the monoclinic phase. Author (NSA)

N71-25232# Dow Chemical Co., Golden, Colo.
TEMPERATURE-INDUCED SHAPE MEMORY IN POLYCRYSTALLINE URANIUM-BASE NIOBIUM ALLOYS: CHARACTERIZATION
Ross J. Jackson and Wilbur L. Johns 23 Sep. 1970 7 p refs
(Contract AT(29-1)-1106)
(RFP-996) Avail: NTIS

Certain polycrystalline uranium-base niobium alloys undergo unusual shape changes on heating or cooling. The shape changes were athermal and under certain conditions completely reversible. This behavior is referred to as temperature-induced shape memory. The shape changes occurred in the composition range of 6 to 21 atomic % Nb and in the temperature range of −200 to +400 C. For the alloy to exhibit shape memory, it must first be cooled rapidly from the gamma region and then subjected to a plastic deformation below 425 C. The effects of composition, temperature, time at temperature, and types of strain, on the shape memory, are discussed. Author (NSA)

N71-25262# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
EFFECT OF WATER VAPOR, REDUCED OXYGEN CONCENTRATIONS, AND SOLVENT VAPORS ON PLUTONIUM IGNITION
Larry E. Musgrave 28 Jan. 1971 7 p refs
(Contract AT(29-1)-1106)
(RFP-1566) Avail: NTIS

The effects of water vapor, reduced oxygen concentration, and chlorinated solvent vapor on the ignition of various sizes of samples of unalloyed and alloyed plutonium were studied. Storing unalloyed plutonium lathe turnings in moist atmospheres reduces the ignition temperature, but storing plutonium 1-wt% gallium alloy lathe turnings in moist atmospheres raises the ignition temperature regardless of the moisture level. Adding nitrogen to reduce the oxygen concentration does not, generally, change the ignition temperature. However, the intensity of the reaction is reduced, and at low concentrations ignition is prevented. The presence of carbon tetrachloride vapor lowers the ignition temperature of plutonium, but the presence of perchloroethylene vapor has no effect. Author (NSA)

N71-25381*# General Electric Co., Cincinnati, Ohio. Space Div.
ADVANCED REFRACTORY ALLOY CORROSION LOOP PROGRAM Quarterly Progress Report for Period Ending 15 Jan. 1971
J. P. Smith 1 Feb. 1971 29 p refs
(Contract NAS3-6474)
(NASA-CR-72853; GESP-606; QPR-23) Avail: NTIS CSCL 11F

Posttest evaluation of the 10,000 hour T-111 Rankine System Corrosion Test Loop was completed. Microprobe examination of the high oxygen area of the potassium swirler wire insert indicated the presence of a complex potassium compound. Tensile tests of specimens from the potassium vapor carryover line have confirmed the reduced ductility indicated by preliminary bend tests. The 1900 F lithium loop continued to operate smoothly and trouble free, and as of 15 January 1971 had logged a total accumulated test time of 6538 hours. Except for final installation of the loop on the vacuum test chamber, assembly of the lithium thermal convection loop is complete, as well as installation of thermocouples and Cb-1Zr dimpled foil thermal insulation. Author

N71-25448*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPLORATORY STUDY OF OXIDATION-RESISTANT ALUMINIZED SLURRY COATINGS FOR IN 100 AND WI-52 SUPERALLOYS
James L. Smialek Washington May 1971 22 p refs
(NASA-TN-D-6329; E-6125) Avail: NTIS CSCL 11F

Two coatings, (1) nickel-aluminide and (2) iron-aluminide plus iron-chromium-aluminum, were produced on IN 100 and WI-52 by a two-step coating process: slurry spraying followed by pack aluminizing. The coated superalloys were cyclically furnace tested in air at 1093 C for 300 hr. Nickel-aluminide coatings offered good protection from oxidation throughout the test, whereas the iron-aluminide plus iron-chromium-aluminum coatings were protective to only 200 hr. Nickel-aluminide-coated IN 100 also survived 300 hr of testing in a high velocity burner rig at 1093 C. Author

N71-25454*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
IMPROVED ALUMINIDE COATINGS FOR NICKEL BASE ALLOYS Final Report
M. A. Levinstein and J. R. Stanley 12 Mar. 1971 175 p refs
(Contract NAS3-11160)
(NASA-CR-72883) Avail: NTIS CSCL 11F

Improved aluminide coatings for the NASA 6A nickel-base superalloy, developed for high-temperature jet engine components, were investigated. Coatings involved modifications of a base system representative of three approaches to improve coating stability: 1) oxide particle embedment, 2) chromium enrichment, and 3) aluminum enrichment. Both single-step and duplex coating processes were used. Coatings were tested at 2000 F (1366 K) in dynamic oxidation using both high- and low-velocity cycle burner rigs and ballistic impact. Coating systems identified exceeded 660 hours life at Mach 0.5 and 2000 hours at low velocity. Tensile and stress-rupture properties of NASA 6A were not affected by the coatings. Author

N71-25455# Oak Ridge National Lab., Tenn.
COMPARISON OF NICKEL AND IRON HEAT BLOCK SHIELDS
G. Samuels Jan. 1971 38 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3213) Avail: NTIS

The performance of nickel and iron heat block-shields for the Isotope Kilowatt Program is evaluated for both organic and steam Rankine cycle systems and for thermoelectric systems with hot junction temperatures of 1050 and 1350 F. The physical properties of nickel are much superior to those of iron or steel for use as the heat block-shield material. It has a much higher thermal conductivity, better shielding properties (higher density), does not undergo the crystalline transformation characteristic of iron or steel, and can be used in a smaller and lighter system. Its primary

disadvantage is that the heat block-shield unit will cost about $35,000 more than iron or steel. However, this increase in cost will be partially offset by a reduction in the size and cost of the pressure vessel. Nickel is satisfactory for all of the systems under consideration while iron or steel is probably acceptable for all except the high temperature thermoelectric unit. Author (NSA)

N71-25503*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.

ADVANCED SUPERALLOY PROTECTION SYSTEMS EVALUATION Final Report

R. K. Betts and T. J. McCauley 8 Apr. 1971 89 p

(Contract NAS3-12414)

(NASA-CR-72852) Avail: NTIS CSCL 11F

Metallliding parameters were developed for the sequential deposition of Mn + Cr, Al + Y and Ta + Al to NASA/TRW 6-A alloy. Efforts to deposit Cr + Y and Y + Zr by metallliding were unsuccessful. None of the applied systems exhibited good ballistic impact resistance. The 2000 F (1367 K) oxidation resistance (dynamic or static) of all metallided systems studied was below that of conventional CODEP-type pack aluminide coating on superalloys. Surface alloying by metallliding did not even closely appear to synthenize the structures or chemical distribution of the bulk alloys on which coating design principles were based. Straight aluminiding was the exception. Author

N71-25512# Argonne National Lab., Ill.

TABULATION OF THE INTERIONIC POTENTIAL IN THE ALKALI METALS

D. L. Price, K. S. Singwi, Wei-Mei Shyu, and M. P. Tosi Nov. 1970 17 p refs

(Contract W-31-109-eng-38)

(ANL-7761) Avail: NTIS

A tabulation of the effective interionic potential for the five alkali metals is presented. The potential is based on self-consistent treatment of correlations in the electron liquid. A simple form for pseudopotential has been used in which the only parameter is the core radius. Appropriate values of the core radius have been determined from an analysis of phonon dispersion curves and interatomic force constants. The value for cesium, for which these data do not exist, has been obtained by extrapolation. Author (NSA)

N71-25513# Minnesota Univ., Minneapolis. Dept. of Chemical Engineering and Materials Science.

THERMOTRANSPORT OF SOLUTES IN LIQUID SILVER

B. N. Bhat and R. A. Swalin 1971 29 p refs Sponsored by AEC

(COO-841-22) Avail: NTIS

A thermotransport study of liquid silver which contained trace amounts of gold, antimony and sulfur has been made. An alloy sample, encapsulated in narrow quartz capillary, was held in a temperature gradient till the stationary state was attained. The sample was analyzed for the solute concentration (C2) along its length. Gold was observed to migrate to the cold end while antimony and sulfur migrated to the hot end. The net heat of transport consisted of two parts: (1) the extrinsic part which arises from the interaction of electrons with solute ion, and (2) the intrinsic part arising from the interaction of diffusing ion with its neighboring ions. Good agreement was obtained between the experimental and calculated values of heats of transport. Author (NSA)

N71-25514# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.

METASTABLE fcc Fe-Rh ALLOYS AND THE Fe-Rh PHASE DIAGRAM

Clinton C. Chao, Pol Duwez, and Chang C. Tsuei Feb. 1971 8 p refs

(Contract AT(04-3)-822)

(CALT-822-23) Avail: NTIS

Single phase metastable face-centered cubic Fe-Rh alloys have been obtained by rapid quenching from the liquid state over a wider range of compositions than formerly reported. Lattice spacings and Mossbauer spectra of Fe-57 of these alloys have been measured at room temperature. Both lattice parameters and isomer shifts are found to vary smoothly with rhodium concentration. These experimental findings suggest the existence of a continuous gamma field at high temperatures. A tentative phase diagram based on the results of the present investigation is proposed. Author (NSA)

N71-25515# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.

MAGNETIC STATES IN AMORPHOUS Fe-Pd-Si ALLOYS

Ryusuke Hasegawa Mar. 1971 16 p refs

(Contract AT(04-3)-822)

(CALT-822-24) Avail: NTIS

Low temperature measurements of electrical resistivity, magnetic susceptibility and magnetoresistivity for the amorphous Fe sub x (Pd82Si18) sub 100−x alloys where x is changed between 0.1 and 0.9 are reported. The amorphous alloys were prepared by rapid quenching from the liquid state. The polarization of the d-electrons of Pd atoms around a Fe atom is found to persist down to the lowest Fe concentration. No giant moment was observed in the present alloys. The effect of the spin polarization on the Kondo type s-d scattering is absent or very small. Interactions between the d-electrons of the Fe atoms, resulting in the superparamagnetic behavior of the alloys seem to take place below a characteristic temperature and only at higher fields. This is found to be consistent with the magnetoresistivity data. The results of both electrical and magnetic measurements are in quantitative agreement. Author (NSA)

N71-25520# Kentucky Univ., Lexington.

DIFFERENTIAL SCANNING CALORIMETRY AND THERMOGRAVIMETRIC ANALYSIS OF SOME METAL CHELATES AND SOME ADDUCTS OF THESE METAL CHELATES

Gabriel Lynn Tincher (M.S. Thesis) 1970 48 p refs Sponsored by AEC

(ORO-2124-24) Avail: NTIS

The heats of fusion of the rare earth tris chelates of 2,2,6,6-tetramethylheptane-3,5-dione, Ln(thd)3 have been determined using differential scanning calorimetry (DSC). Adducts of the Ln(thd)3 complexes with pyridine, beta-picoline, and gamma-picoline have been prepared and the thermal decomposition of these adducts studied by DSC and thermogravimetric techniques. Thermal analysis of adducts of Bis (0,0'-di-isopropyldithio-phosphato) nickel (II), Ni(i-Pr-dtp)2, with pyridine, beta-picoline, and gamma-picoline was undertaken as a preliminary investigation into the thermal decomposition of metal chelate adducts. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N71-24409# Massachusetts Univ., Amherst. School of Engineering.

DYNAMIC AND STATIC FATIGUE OF SILICATE GLASSES

John E. Ritter, Jr. and Charles L. Sherburne Dec. 1970 96 p refs

(Contract N00014-68-A-0146; Proj. Themis)
(AD-717946; THEMIS-UM-70-9) Avail: NTIS CSCL 11/2

Fatigue of silicate glasses was studied using both static and dynamic tests. Static fatigue data for acid-etched, soda-lime-silica glass determined at 74F in atmospheres of 50 and 100% relative humidity could be represented by a single universal fatigue curve. The UFC for acid-etched glass does not lie on the UFC of Mould and Southwick which was determined for abraded soda-lime-silica glass, the acid-etched glass being less susceptible to static fatigue. On comparing the fatigue behavior of acid-etched, soda-lime-silica glass to that of pristine E-glass and fused silica fibers, little difference was found in the susceptibility to static fatigue. In addition, dynamic fatigue data for a wide variety of silicate glasses (soda-lime-silica, E-glass, pyrex, and fused quartz) was compared to fundamental crack velocity data for these glasses utilizing the dynamic fatigue theory of Charles. Agreement was good on both a quantitative and qualitative level. The theoretical implications of these results on static and dynamic fatigue are discussed. Author (GRA)

N71-24410# Texas A&M Research Foundation, College Station.
VISCOELASTIC BEHAVIOR OF A NONLINEAR FIBER REINFORCED PLASTIC Final Report, 1 Feb. 1967 – 30 Nov. 1969

Y. C. Lou and R. A. Schapery May 1970 87 p refs Prepared for Purdue Res. Foundation
(Contract F33615-67-C-1412)
(AD-718978; AFML-TR-70-113) Avail: NTIS CSCL 11/9

The nonlinear, viscoelastic behavior of a unidirectional, glass fiber-epoxy composite material is characterized by using isothermal, uniaxial creep and recovery tests together with a constitutive equation based on a thermodynamic theory. First, linear stress-strain equations for both uniaxial and multiaxial loading of orthotropic materials are reviewed, and then the nonlinear constitutive equation for uniaxial loading is given. Following a discussion of experimental aspects, creep and recovery data obtained from several different specimens (each having a different fiber orientation relative to the loading axis) are used together with a graphical shifting procedure to evaluate all material properties. Some simplicity in the analytical representation of the data is found; viz., the creep compliance obeys a power law in time with the exponent being independent of fiber orientation and stress level, and the nonlinear properties depend mainly on the average octahedral shear stress in the matrix. These properties are used to make various predictions of viscoelastic behavior, and good agreement with the experimental data is found. Finally, a limited study of the effect of temperature on creep is made. Author (GRA)

N71-24427# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MACHINING UNDER CONDITIONS OF HIGH STATIC PRESSURES OF LUBRICATING COOLING MEDIUM

V. M. Yaroslavtsev et al 9 Dec. 1970 13 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Mashinostro. (Moscow), no. 12, 1969 p 172 – 176
(AD-719812; FTD-MT-24-240-70) Avail: NTIS CSCL 13/8

A description is presented of the results of experimental investigation on the machining method in which a high static pressure was created in the cutting zone. Tests were conducted in drilling small holes 3mm in diameter and 13 mm deep. Lubricating-cooling fluid was fed under pressure from 3 to 50 at. The results show that high static pressure of the fluid results in the reduction of tool wear and improvement of the machined surface finish. Author (GRA)

N71-24429# Army Materials and Mechanics Research Center, Watertown, Mass.
ANALYSIS OF TRANSVERSE CRACKS IN STIFFENED FIBER, COMPOSITE STRIP UNDER TENSION

Chatta Lakshmikantham Jan. 1971 21 p
(AD-719696; AMMRC-TR-71-1) Avail: NTIS CSCL 11/4

The stress analysis of a central transverse crack in a stiffened fiber reinforced composite panel under tension is treated. The existing analytical techniques for the isotropic problem of a crack in an infinite strip, based on the well-known Schwarz Alternating Method for multiply-connected domains, are applied to the present orthotropic problem. The ratio of stress intensity factors for the finite plate to that of the infinite plate is obtained as a function of the crack length. The results are compared with the isotropic solution. Author (GRA)

N71-24602# Naval Ordnance Lab., White Oak, Md.
AROMATIC IMIDE-QUINOXIALINE COPOLYMERS

James V. Duffy and Joseph M. Augl 6 Jan. 1971 19 p refs
(AD-719408; NOLTR-70-247) Avail: NTIS CSCL 7/3

Four new imide-quinoxaline copolymers were synthesized and characterized. These polymers were prepared by a one step condensation reaction between aromatic bis(o-diamines) and N,N-bis(4-benzilyl)-3,3,4,4-benzophenonetetracarboxylimide. Polymer decomposition temperatures lie between 490-530C, and all polymers are soluble in a number of different solvents. Strong fibers and films have been made from m-cresol solutions. Author (GRA)

N71-24670# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
THE DOSIMETRIC USE OF BERYLLIUM OXYDE AS A THERMOLUMINESCENT MATERIAL: A PRELIMINARY STUDY

G. Scarpa 23 Jul. 1970 32 p refs Presented at the 2d Congr. of the Intern. Radiation Protection Assoc., Brighton, England, 3 – 8 May 1970
(RT/PROT-(70)23; CONF-700505-15) Avail: AEC Depository Libraries

Results of a preliminary study on the dosimetric characteristics of three different grades of commercial beryllium oxide are reported. The samples were made available by a British firm in the form of sintered disks. Among useful features of this promising thermoluminescent material, a very low sensitivity to thermal neutrons, a fairly high sensitivity to gamma rays, and a good energy response are emphasized. These parameters allow beryllium oxide to be used in mixed fields of thermal neutrons and gamma rays, such as in nuclear reactors facilities. Sensitivity to fast neutrons was found to be between 6 and 9% of that to Co-60 gamma rays. Other parameters tested were glow curve, fading, linearity with dose, and light decay. Author (NSA)

N71-24838# Naval Ordnance Lab., White Oak, Md.
SYNTHESIS AND EVALUATION OF NEW PHENYLATED POLYQUINOXALINES. 2

Joseph M. Augl and Wolfgang Wrasidlo 15 Dec. 1970 22 p ref
(AD-719407; NOLTR-70-231) Avail: NTIS CSCL 7/3

The synthesis and properties of two new phenylated polyquinoxalines are discussed. Additional properties data from two related earlier synthesized polymers were obtained and compared with those of the new polymers. It was found that polymers from 1,4-bis(phenylglyoxaloyl)benzene and 1,3-bis(phenyldlyoxaloyl) benzene with 3,3-diaminobenzidine are almost identical in their thermal properties. Their decomposition temperature (vacuum) is 540C. Weight loss at 400C in air is only six per cent. They are both stable in hot concentrated alkali and show excellent solubility in a number of common solvents. Author (GRA)

N71-24877# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CARBIDIZING OF SPHERICAL POWDERS OF NIOBIUM, MOLYBDENUM, AND TUNGSTEN

A. N. Kraskov et al 12 Nov. 1970 12 p refs Transl. into ENGLISH from Akad. Nauk Ukr. SSR, Inst. Probl. Materialovedeniya, Zashchitn. Pokrytiya na Metallakh (Kiev), no. 2, 1968 p 261-268
(AD-719783; FTD-HT-23-552-70) Avail: NTIS CSCL 11/3

The deals with the carbidizing (in lamp-black) of such refractory metals as Nb, Mo and W, obtained in powder form by means of plasma-jet atomizing. The following powder fractions were used: 1200, 800, 700, 500, 400, 300, 250, 200 and 100 mu m. Diffusion annealing was carried out at 1973K for Nb, 1673 and 1773K for Mo and 1873K and 1973K for W, and the time of the diffusion plating of each of the above spherical particle fractions in relation to the above temperatures, required to obtain a carbide coating of specified depth, was calculated with the aid of a Minsk-12 computer. GRA

N71-24879# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF TEMPERATURE AND MEDIUM ON ANTIFRICTION PROPERTIES OF SOLID LUBRICANTS
Sh. E. Barsegyan 12 Nov. 1970 7 p Transl. into ENGLISH from Proc. of 1st Nauchn. Konf. Aspirantov Ordena Trudovogo Krasnogo Znameni Inst. Probl. Materialovedeniya (Kiev), 1968 p 160-165
(AD-719786; FTD-HT-23-563-70) Avail: NTIS CSCL 11/8

The report presents the results of experimental research on the antifriction properties of solid lubricants of disulfides and diselenides of transition metals at high temperatures in air, nitrogen, and argon media under both normal pressure and in a vacuum. The solid lubricants tested were obtained by the interaction of powders of corresponding metals with sulfur or selenium in a current of hydrogen sulfide or hydrogen selenide. For comparison with synthetic solid lubricants, a real (natural) molybdenum disulfide was also used. Author (GRA)

N71-24934* Northrop Space Labs., Hawthorne, Calif.
METHOD OF EVALUATING MOISTURE BARRIER PROPERTIES OF ENCAPSULATING MATERIALS Patent
William Bert Ellern, inventor (to NASA) Issued 22 Dec. 1970 (Filed 11 Mar. 1968) 7 p Cl. 73-38; Int. Cl. G01n15/08 Sponsored by NASA
(NASA-Case-NPO-10051; US-Patent-3,548,633; US-Patent-Appl-SN-711898) Avail: US Patent Office CSCL 11D

A procedure is described for evaluating the moisture barrier properties of materials used in encapsulation of electronics such as conformal coatings and embedment resins. A humidity sensitive element such as a dry carbon composition resistor is encapsulated with the candidate material. The assembly is subjected to a humid environment, and the change in resistance representing an indication of the penetration of moisture through the encapsulating material is determined. The pressure of the encapsulating material and the temperature effects of the environment can also be determined. Official Gazette of the U.S. Patent Office

N71-24938# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHODS OF EVALUATING THE ANTIWEAR AND ANTISCORING PROPERTIES OF LUBRICANTS
G. B. Vinogradov et al 15 Dec. 1970 308 p refs Transl. into ENGLISH from the book "Metody Otsenki Protivozadirnykh i Protivoiznosnykh Svoystv Smaz. Materialov" USSR, 1969 p 1-230
(AD-719775; FTD-HC-23-212-70) Avail: NTIS, HC $6.00/MF $0.95 CSCL 11/8

The collection contains material from a conference on methods of rating the antiscoring and antiwear properties of lubricating materials. The present state of the oil-testing problem is discussed, the results of research on the antifriction effectiveness of various lubricants for various conditions of application are presented, and a new treatment of the lubricating mechanism of oils and solid lubricants is submitted. Machines and techniques for property testing of lubricants are described. Author (GRA)

N71-24946 Lehigh Univ., Bethlehem, Pa.
A BASIC STUDY OF SINTERING OF AN AMORPHOUS POLYMER: POLYMETHYL METHACRYLATE
Gail R. Garberini Steiner (Ph.D. Thesis) 1969 220 p
Avail: Univ. Microfilms Order No. 70-10621

Photomicrographs of the sintering spheres were taken during the sintering process and sintering data obtained from these photomicrographs. The important parameters which were varied in the sintering studies were: temperature, sphere size, surface treatment, and molecular weight. Sintering rates were found to be dependent upon sintering temperature and molecular weight and independent of sphere size (for the size range studied, 50-250 microns), and surface treatment. The mechanism of sintering of polymethyl methacrylate is viscous flow at high temperatures and viscoelastic flow at lower temperatures with the elastic component of flow increasing as the temperature is decreased. The apparent activation energy, E sub A, of sintering of polymethyl methacrylate at high temperatures is the same as that of simple viscous flow, 37-40 kcal/mol. The sintering results were compared with those predicted by the Frenkel approximation. Dissert. Abstr.

N71-24947 Catholic Univ. of America, Washington, D.C.
THE EFFECT OF COMPOSITION FLUCTUATIONS ON STRUCTURAL RELAXATION
Joseph H. Simmons (Ph.D. Thesis) 1969 124 p
Avail: Univ. Microfilms Order No. 70-8803

Ultrasonic spectroscopy was performed on four molten oxide glasses with various immiscibility temperatures, but closely related structures. The spectra of relaxation times were found to be highly temperature dependent, increasing from a single relaxation time at high temperatures, far from the critical point, to broad distributions close to the critical point. A model was developed from critical fluctuation theory, and was proposed to explain the observed temperature dependence of the spectrum in terms of composition fluctuations. A correlation function was proposed which better explained the data than the existing Ornstein-Zernike-Debye theory, and was more compatible with recently reported low angle X-ray scattering data. These results lead to an understanding of the causes behind the occurence of distributions of activation energies in molten oxides, and propose a means of investigating the structure of viscous liquids. Dissert. Abstr.

N71-24972# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRUCTURAL PROPERTIES OF PLASTICS
I. V. Kragelskii 10 Dec. 1970 234 p refs Transl. into ENGLISH of the book "Konstrukt. Svoistva Plastmass" Moscow, 1968 p 1-212
(AD-719780; FTD-HC-23-625-70) Avail: NTIS CSCL 11/9

Questions concerned with the investigation of the characteristics of deformation and rupture of plastics are discussed, as well as the friction and antifriction properties of the plastics. Methodological peculiarities in the study of the characteristics applicable to polymer materials and glass-reinforced plastics are set forth. Considerable attention is paid to the use of experimental data to estimate the carrying capacities of roller and slide bearings. The properties of the plastics under static, dynamic and shock loads, strength under contact load, strength with unilateral heating, physico-mechanical, friction and antifriction properties of polymer bearings and self-lubricating materials are discussed in detail. Actual data is given on the indicated characteristics and recommendations are made according to test equipment and apparatus. Author (GRA)

N71-24974*# Marquardt Corp., Van Nuys, Calif.
REFRACTORY COMPOSITE MATERIALS FOR SPACECRAFT THRUST CHAMBERS Final Report, 23 Jul. 1968–22 Feb. 1970
C. D. Coulbert, J. S. Waugh (Raytheon Co.), and J. G. Campbell
7 May 1971 166 p refs
(Contract NAS7-555)
(NASA-CR-118321; S-989) Avail: NTIS CSCL 11D

A family of pyrolytically bonded (Pyrobond) materials has been formulated which combines the erosion resistance of a pyrolytic refractory thrust chamber inner wall with the high strength and fabrication flexibility of a carbon fiber composite structure. These material systems were evaluated theoretically and experimentally in structural and hot firing tests with FLOX/methane propellants. A total of nine different 100-lb thrust refractory composite chambers, plus a hafnium carbide coated tantalum-10 tungsten chamber, seven POCO heavy wall graphite chambers, and six free standing pyrolytic graphite chambers were test fired with FLOX/methane propellants at 100 psia. A total of 2800 seconds of hot firing was accumulated during three test periods. Combustion efficiencies between 89 and 98 percent were attained as a function of chamber values between 10 inches and 18 inches. During these tests, both chamber erosion and carbon deposition were evaluated locally in the chamber from the injector to the nozzle throat as a function of fuel film flow, wall material, and duty cycle. Author

N71-25104# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD FOR DETERMINING THE MELTING TEMPERATURE OF THE ASH OF LUBRICATING OIL ADDITIVES
F. G. Suleymanova et al 30 Nov. 1970 9 p Transl. into ENGLISH from Prisadki Smaz. Maslam (USSR), no. 2, 1969 p 186–189
(AD-719767; FTD-HT-23-720-70) Avail: NTIS CSCL 11/8

A physical instrument for determination of the melting temperature of the ash portion of lubricating oil additives was developed, assembled, and tested. Besides the determination of the melting temperature of ash in lubricating oil additives, this instrument can be used to determine the melting temperature of any inorganic and nonmetallic substances. The recording of the research results in the potentiometer in the form of diagrams makes it possible to study the behavior of additive ash in a broad temperature interval. Research works on the indicated instrument have shown that it is possible to use it to study the process of oxidation of oil with respect to thermal effect. Author (GRA)

N71-25117# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANTIFRICTION PLASTIC BASED ON POLYAMIDE FIBER
N. S. Kozopolyanskiy et al 16 Nov. 1970 11 p refs Transl. into ENGLISH from Khim. Tekhnol. (Dnepropetrovsk), no. 12, 1969 p 106–110
(AD-719827; FTD-HT-23-549-70) Avail: NTIS CSCL 11/9

In a number of cases when antifriction plastics are used in friction units of rolling mills, where great strength is required, even textolite (possessing high physicomechanical indices) do not withstand the impact loads. The application of polyamide synthetic fibers as fillers for phenol resins makes it possible to obtain a material which has high resistance to moisture, impact strength, and wear resistance. In the reported work caprone fiber and phenol-formaldehyde resin were used to prepare plastics, which were then investigated. Author (GRA)

N71-25215# WADCO Corp., Richland, Wash.
THERMAL AND INFRARED NONDESTRUCTIVE TESTING OF COMPOSITES AND CERAMICS
Donald R. Green 5 Oct. 1970 33 p refs Presented at 30th Natl. Fall Conf. of the Amer. Soc. for Nondestructive Testing, Cleveland
(Contract AT(45-1)-2170)
(WHAN-SA-42; CONF-701034-1) Avail: NTIS

The application of high-speed thermal and infrared methods to the detection of density differences, cracks, voids, and other defects in ceramics and composites is described. A single-pass induction heating method, made possible with a full-width paint brush heating coil, was used in infrared tests on carbon-carbon composites. Unique characteristics of the induction heating make it possible to detect cracks that are perpendicular as well as parallel to the surface of the test specimen. All of the materials were also tested using the new low-cost thermal image transducer, and the resolution and sensitivity to defects were determined. Both the infrared method and the thermal transducer method are capable of completing a test on a large area in a few seconds (not including specimen handling time). Author (NSA)

N71-25318*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EFFECTS ON SURFACE FINISHING ON THE STRENGTH OF CERAMIC MATERIALS
Thomas M. Heslin *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 253–255
(See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 11B

The relationships between Al203 surface conditions and the distribution of strength values are studied in an effort to improve ceramic materials. Strength- and flaw magnitudes are correlated by various statistical and empirical relations, and flaw elimination and compensation procedures are considered. Compressive glazing is established as the most effective strength increasing technique that provides for best flaw compensation. G.G.

N71-25426*# General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs Dept.
FABRICATION STUDIES FOR T-111 HONEYCOMB STRUCTURE Final Report
S. R. Thompson and W. R. Young 15 Apr. 1971 156 p
(Contract NAS3-13451)
(NASA-CR-72851; GESP-570) Avail: NTIS CSCL 11D

Electron beam and gas tungsten arc welding techniques were investigated to determine the feasibility of manufacturing a tantalum-111 alloy model honeycomb structure. The study model configuration was representative of the core of a compact nuclear power plant assembly. Optimum weld conditions were selected by destructive evaluation of parameter study specimens. Mechanical property tests, performed on representative samples, demonstrated the satisfactory load carrying capabilities of each type of weld. Dimensional inspection of subsequent tube-to-tube and tube insert-to-tube sample assemblies, using full length honeycomb tubes, established that distortion from weld shrinkage would be a major difficulty in full scale assemblies. The study also demonstrated that visual examination of the face and root sides of the weld joints could adequately define weld quality. Author

N71-25437# Oak Ridge National Lab., Tenn.
ON THE THERMAL STABILITY OF ETA-CARBIDES
P. Ettmayer et al 1971 5 p refs Transl. into ENGLISH from Monatsh. Chem. (Austria), v. 101, 1970 p 1098–1103
(ORNL-tr-2425) Avail: NTIS

The occurrence of eta-carbides of type A3B3C, A2B4C, and A6B6C (A = Fe, Co, Ni), (B = Mo, W) has been investigated. With the exception of the system Fe–Mo–C the formation of a phase A6B6C could be observed in all systems. The phase Co6Mo6C is not stable at temperatures exceeding 1000 C, but undergoes a decomposition to Co3Mo3C and mu-phase (Co7Mo6). Three structurally related eta-phases are observed in the system Co–W–C in the temperature range 1100 to 1350 C: Co6W6C,

Co3W3C, and Co2W4C. Below 1100 C the phase Co3W3C is unstable and decomposes, forming Co6W6C, and Co. Isothermal sections of the systems Co–W–C are drawn for the temperatures 1100 and 1300 C. Author (NSA)

N71-25447*# Union Carbide Corp., Tonawanda, N.Y. Linde Div.
LIGHTWEIGHT MODULAR MULTILAYER INSULATION Final Report
G. E. Nies 26 Feb. 1971 257 p refs
(Contract NAS3-12045)
(NASA-CR-72856) Avail: NTIS CSCL 11D

The design of a Self Evacuating Multilayer Insulation (SEMI) system for a 10 ft diameter by 20 ft long liquid hydrogen tank is described. The design, fabrication, and testing of a model system simulating the full size insulation system is also presented. Model system testing included both thermal and structural evaluations. Thermal tests, using liquid hydrogen and structural tests were performed. The SEMI system was subjected to a combined launch vacuum profile to simulate a typical launch profile. The system performed as designed. The SEMI system materials, consisting of composite layers of rigid open cell polyurethane foam and double aluminized Mylar radiation shields were unaffected by the dynamic testing. A heat flux of 1.3 Btu per hour was measured before and after the dynamic tests. The three panel, 18 radiation shield system offers a lightweight cryogenic insulation. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also: 08 Computers.

N71-24370# National Physical Lab., Teddington (England). Div. of Numerical and Applied Mathematics.
EXISTENCE OF A CAPILLARY SURFACE IN A RIGHT CIRCULAR CYLINDER
P. Concus Feb. 1971 10 p refs
(NPL-Ma-95) Copyright. Avail: NTIS

The equation determining the capillary free-surface of a volume of liquid that partially fills a cylindrical container having right section is reduced to an ordinary differential boundary value problem. Existence of a solution to this problem is demonstrated by using a technique of investigating the behavior of a meridian of the free surface. It is shown that for K greater than or equal to 0 (capillary constant) there exists a solution for any contact angle gamma. ESRO

N71-24430# Air Force Academy, Colo. Frank J. Seiler Research Lab.
A NEW ADAPTIVE CONTROL TECHNIQUE
John F. Schaefer Feb. 1971 12 p refs Presented at Joint Autom. Control Conf., Philadelphia, 29 Jun. 1967
(AD-719743; SRL-TR-71-0004) Avail: NTIS CSCL 12/1

An adaptive controller is synthesized in response to requirements exposed by a study of a low-order unstable mechanical system driven by a bang-bang actuator. The subject plant consists of a rigid rod pinned to a motor-driven cart; a mass mounted somewhere on the rod constitutes the unknown parameter in the system. The goal is to synthesize control logic which can cope with the unknown mass locations and stabilize the system from all potentially controllable initial conditions. The evolved adaptive technique differs from previously developed methods in that adaption takes place during chatter motion of the controller. These developments arose from study of a higher-order mechanical system whose equations of motion are similar to those describing the planar motion of an aerodynamically unstable missile. The technique appears to be applicable to missile control and generalizable to an even broader class of systems. Author (GRA)

N71-24470*# Massachusetts Inst. of Tech., Cambridge. Charles Stark Draper Lab.
LINEAR, KALMAN, AND EPOCH STATE FILTERING TECHNIQUES Quarterly Progress Report, 1 Dec. 1970–30 Apr. 1971
30 Apr. 1971 115 p refs
(Contract NAS9-10386)
(NASA-CR-115010; MIT-71-412L-1; QPR-4) Avail: NTIS CSCL 12A

Developments in mathematical analysis techniques are presented. Subjects discussed are: (1) avoiding the loss of positive definiteness of the estimation error covariance matrix in the linear filtering problem, (2) computational errors in Kalman filtering problems, (3) new version of the Kalman filter that uses prefiltering of a time block of measurements to obtain a pseudo discrete equivalent measurement, and (4) application of mathematics to problems in air and space navigation. Author

N71-24483# National Physical Lab., Teddington (England). Div. of Numerical and Applied Mathematics.
NUMERICAL EVALUATION OF THE DOWNWASH INTEGRAL FOR A LIFTING RECTANGULAR PLANFORM
Valerie A. Ray and G. F. Miller Dec. 1970 24 p refs
(NPL-Ma-90) Copyright. Avail: NTIS

A method is described for the accurate evaluation of the downwash integral of Multhopp's lifting surface theory for wings of rectangular planform subjected to very general loadings. In the form in which it was originally derived the integral defining the downwash alpha(x,y) at points on the wing surface is unsuitable for numerical calculation because of the presence of a strong singularity of the integrand at the point (x,y). The basis of the present method is to transform the integral by removing certain terms which (subject to natural assumptions regarding the form of the loading function alternate theta(x,y) can be evaluated in closed form, while the remaining integral is only weakly singular and is amenable to numerical evaluation. The method has been embodied in a KDF 9 program which computes the downwash, for arbitrary values of the aspect ratio, to high precision. Tables and digrams are appended, giving values of the downwash at a representative set of points on the wing for several aspect ratios and loadings. A basic aim has been to provide a definitive set of results of substantial precision against which results obtained by other methods (possibly applicable to more general shapes) may be tested. Author (ESRO)

N71-24631*# Center for Advanced Study, Huntsville, Ala.
SAMPLED DATA SYSTEMS AND GENERATING FUNCTIONS
Charles A. Halijak (Ala. Univ., Huntsville) 29 Mar. 1971 41 p refs
(NASA Order H-68639A)
(NASA-CR-61349) Avail: NTIS CSCL 12A

A lengthy and formal acquaintance with Z-transforms is presented. A formal study of Z-transforms pays off by relegating physical applications to very easy corollary status. Physical applications studied are: (1) the numerical transform, the natural transition from analog to discrete systems; (2) sampled-data feedback devices; (3) multiplexing and demultiplexing; (4) periodically reverse switched capacitor; (5) pulse code modulation decoders; (6) the sampled-data servo; and (7) proper and subharmonic digital filters. Author

N71-24632*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
METHODS OF AVERAGES EXPANSIONS FOR ARTIFICIAL SATELLITE APPLICATIONS
Jack Lorell and Anthony Liu 1 Apr. 1971 24 p refs
(Contract NAS7-100)
(NASA-CR-118267; JPL-TR-32-1513) Avail: NTIS CSCL 12A

Formulas for the averaged potential in artificial satellite theory are derived. The potential due to gravity harmonics is

developed for the general nm harmonic. That due to a third body is developed up to the fifth degree in R/R sub 3, the small distance-ratio. The expressions given differ from ones generally available in the literature in that they do not depend on expansions in either eccentricity or inclination. In addition, a discussion is included of the use of the method of averages for tesseral harmonics. In the case of the rapidly rotating planet Mars, the method is constrained to the evaluation of zonal harmonics. For more slowly rotating bodies such as the moon, all tesseral harmonics can be included. Author

N71-24874*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
FAILURE ACCOMMODATION IN LINEAR SYSTEMS THROUGH SELF-REORGANIZATION
Richard Vernon Beard (Ph.D. Thesis) Feb. 1971 377 p refs
(Grant NGL-22-009-025)
(NASA-CR-118314; MVT-71-1) Avail: NTIS HC $6.00/MF $0.95 CSCL 12A

Methods of self-reorganization are developed which can provide a complex linear dynamic system with the ability to restructure itself to compensate for failures in its effectors and sensors and changes in the linear dynamics. The approach taken is to identify the failure or change in the system and use that information to restructure a feedback control loop to maintain closed-loop stability if possible. Controllability and observability criterion are used to evaluate the potential ability of a system to tolerate failures. A lower bound is established for the number of effectors and sensors a linear time-invariant system requires for complete controllability and observability. The problem of identifying failures and changes in the system is solved through the use of detection filters, which produce error signals indicating the location of a failure or change. Extensive results are developed on the design of a filter capable of detecting a substantial number of different failures or changes. Practical design algorithms are presented. Author

N71-24885*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AMPLITUDE DISPERSION AND STABILITY OF DISSIPATIVE WEAKLY NONLINEAR WAVES
Ferdinand F. Cap May 1971 18 p refs Submitted for publication
(NASA-TM-X-65524; X-640-71-179) Avail: NTIS CSCL 12A

A perturbation method to solve nonlinear dissipative wave equations is presented. The method is compared to Whitham's theory. Dispersion relations for nonlinear dissipative waves, including amplitude dispersion, are discussed and stability problems of such waves are investigated. Author

N71-24935# Maryland Univ., College Park. Center for Theoretical Physics.
A NOTE ON FIRST ORDER FUNCTIONAL EQUATIONS
Jesse Grodnik May 1971 13 p ref
(Grant NSF GU-2061)
(TR-71-110) Avail: Issuing Activity

A previous study revealed that in quantum field theory certain mathematically important ground state expectation functionals satisfy a system of linear functional equations. In order to obtain the necessary insight for treating such equations the present investigation considers the simpler problem of obtaining formal solutions of first order functional equations. Author

N71-24983# Maryland Univ., College Park. Center for Theoretical Physics.
LORENTZ CONTRACTION OF THE BETHE-SALPETER GREEN'S FUNCTION
Y. S. Kim and Roger Zaoui Apr. 1971 19 p refs
(Grant NSF GP-8748)
(TR-71-101) Avail: Issuing Activity

Lorentz-transformation properties of bound-state Bethe–Salpeter wave functions are discussed. It is noted first that the Lorentz-transformation effect comes through the Green's function in the Bethe–Salpeter integral equation. The transformation properties of the Green's function are then investigated in detail. It is shown that the Green's function exhibits a delta-function-like Lorentz contraction in the high-energy limit. It is shown also that the bound-state wave function has the same contraction property. Author

N71-25118# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHODS OF CYBERNETIC DIAGNOSIS OF DYNAMIC SYSTEMS
Ya. A. Gelfandbeyn 3 Dec. 1970 630 p refs Transl. into ENGLISH of the publ. 'Metody Kiberneticheskoy Diagnostiki Dinamicheskikh Sistem' Riga, 1967 p 1–542
(AD-719776; FTD-HC-23-469-69) Avail: NTIS HC $6.00/MF $0.95 CSCL 12/1

The document contains an analytical study of cybernetic diagnostics of dynamic systems. Various methods of identifying the functioning dynamic systems and processes as well as the structures and media by their mathematical models using only empirical data on disturbances (noise) or signals and their reactions are presented. The proposed method can be applied in science and engineering. Simple mathematical means are used in developing these methods, and examples illustrating their application are presented. The book is intended for scientists and designers working on problems of automation of technological processes and construction of modern control systems, and for specialists involved in related fields. It may also be useful to senior students and aspirants interested in the problems of cybernetic diagnostics GRA

N71-25142# Joint Publications Research Service, Washington, D.C.
A GENERALIZATION OF THRESHOLD FUNCTIONS
N. N. Ayzenberg et al 26 Apr. 1971 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 196, no. 6, 1971 p 1287–1290
(JPRS-52974) Avail: NTIS

The frame of reference of doubled-valued threshold logic is studied for obtaining effective solutions to problems in digital devices, and other fields of cybernetics. A structured alphabet with the symbols considered as some function assigned to a multiplicative Abelian group is examined. A block diagram of a threshold element dependent on N values is presented. F.O.S.

N71-25201# Joint Publications Research Service, Washington, D.C.
ALGORITHMIC INSOLUBILITY OF THE PROBLEM OF FINDING THE ASYMPTOTIC BEHAVIOR OF THE SHANNON FUNCTION WHEN BOUNDED DETERMINATE OPERATORS ARE REALIZED BY SCHEMES ON AN ARBITRARY BASIS
V. A. Orlov 26 Apr. 1971 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 196, no. 5, 1971 p 1036–1039
(JPRS-52973) Avail: NTIS

The insolubility of the problem is proved for the case in which the arbitrary basis is defined as a finite system of finite automatic devices. An infinite sequence of automaton-complete bases is constructed such that in each basis the asymptotics of the Shannon function is of the form cH, where c is a constant dependent on the basis and H is a function dependent on the number of realized operators. Amplifications of the problem obtained by complicating the basic design are also described. N.E.N.

N71-25427# Research Inst. of National Defence, Stockholm (Sweden). Dept. of Electronics.
A SOLUTION OF THE RICCATI INHOMOGENEOUS TRANSMISSION LINE EQUATION [EN LOESNING TILL

RICCATIEKVATIONEN FOER INHOMOGENA LEDNINGAR
A. Bergquist Sep. 1969 28 p refs In SWEDISH; ENGLISH summary
(FOA-3-C-3603-61) Avail: NTIS

A solution is given of the Riccati differential equation for the reflection coefficient on an inhomogeneous transmission line. It takes the form of convergent series which make it possible to attain a high degree of accuracy. Author

N71-25428# Oak Ridge National Lab., Tenn.
INTRODUCTION TO THE NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS IN ECOSYSTEM MODELS
Robert V. O'Neill Dec. 1970 29 p refs
(Contract W-7405-eng-26)
(ORNL-IBP-70-4) Avail: NTIS

Four of the available numerical solution methods for differential equations are evaluated relative to their potential use in ecosystem models. A simplified energy flow model is used to point out potential problems in applying the methods, and a number of criteria are applied to the techniques in an effort to achieve a better understanding of each method. Author (NSA)

N71-25429# Tokyo Univ. of Education (Japan). Dept. of Physics.
FUNCTIONAL INTEGRAL REPRESENTATION FOR THE GREEN'S FUNCTION OF THE DUAL RESONANCE MODEL
Tsunehiro Kobayashi and Ichiro Shibasaki Jan. 1971 28 p refs
(TUEP-71-5) Avail: NTIS

A functional integral method for the renormalization of the dual resonance model is proposed. The Green's function of the dual resonance model is represented in the functional integral form. It is also shown that the free propagator, one loop function, two loop one and so on which have been obtained in the dual resonance model, can be derived from the expansion of the Green's function in power series of the coupling constant. Renormalization problems for some characteristic diagrams are discussed. Author

N71-25458 Tata Inst. of Fundamental Research, Bombay (India).
LECTURES ON QUADRATICJORDAN ALGEBRAS
N. Jacobson 1969 192 p refs
Avail: Issuing Activity

Matrix ring formulations of the Artinian semi-simple ring with involutions are determined, and basic definitions with the general results for quadratic Jordan algebras are given. The Pierce decompositions, the strong coordination theorem, and the structure theory of quadratic Jordan algebras are developed. It is shown that the determination of the simple quadratic Jordan algebras of capacity two can be accomplished quickly for finite dimensional algebras over an algebraically closed field. F.O.S.

N71-25509*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROPAGATORS IN STRONG PLASMA TURBULENCE
T. J. Birmingham and M. Bornatici (European Space Res. Inst., Frascati, Italy) Apr. 1971 9 p refs Submitted for publication Sponsored in part by NAS-NRC- and ESRO
(NASA-TM-X-65513; X-641-71-136) Avail: NTIS CSCL 12A

Straightforward relationships among Weinstock's propagator, the Vlasov propagator, and the ensemble average Vlasov propagator are derived. The Vlasov propagator and the ensemble average Vlasov propagator are related to the characteristic trajectories of the Vlasov Equation. Author

N71-25560 Tata Inst. of Fundamental Research, Bombay (India).
LECTURES ON THE THEOREM OF BROWDER AND NOVIKOV AND SIEBENMANN'S THESIS
M. A. Kervaire 1969 133 p refs
Copyright. Avail: Issuing Activity

Separate proofs are given for the Browder and Novikov theorem and Siebenmann's theorem. Prior to the presentation of proofs for main theorems, the Browder and Novikov theorem is described in terms of the cap-product, Poincare duality, an index of a 4d-dimensional manifold, a theorem statement, surgery or spherical modification, and the effect of surgery on homology. Simple connectedness in the Browder and Novikov theorem is discussed in connection with a statement on Siebenmann's theorem. The existence is examined of arbitrary small 0 and 1, k, and (n-1) neighborhoods for Siebenmann's theorem. E.C.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N71-24375# Army Foreign Science and Technology Center, Charlottesville, Va.
VISIBILITY IN THE ATMOSPHERE
V. A. Gavrilov 28 Jan. 1971 390 p refs Transl. into ENGLISH of the publ. 'Vidimost v Atmosfere' Leningrad, Gidrometeorol. Izd., 1966
(AD-719502; FSTC-HT-23-052-71) Avail: NTIS HC $6.00/MF $0.95 CSCL 4/2

The author gives a description of present-day ways of determining visibility through the atmosphere. He explains how atmospheric transmissivity, the visibility of actual objects, and the range of visibility on landing an aircraft are measured. He emphasizes particularly the methods for determining the level of visibility. In a number of cases he concludes that problems which he regards as being important have not yet been satisfactorily solved. Author (GRA)

N71-24394 World Meteorological Organization, Geneva (Switzerland).
USE OF WEATHER RADAR FOR AVIATION
H. Treussart, W. B. Beckwith, S. G. Bigler, K. Otani, V. V. Kostarev et al 1970 92 p refs Its Tech. Note 110
(WMO-264-TP-148) Copyright. Avail: Issuing Activity

The existing aviation requirements for weather radar, either ground-based or airborne, in connexion with performance criteria, range and accuracy, are reviewed. The detection and identification of regions of hail and turbulence associated with thunderstorms, these being considered dangerous phenomena for aviation are discussed. It is shown through intensive surveys on hail detection that echo intensity, as an indicator of hail, observed using 10 cm wavelength radar exhibited a similar trend to that observed using 3 cm radar, but very little change in intensity with height. Several case studies of the probability of hail as a function of height are also illustrated for assessment of hail. Brief mention is made of the use of airborne radar for detection of hail and the avoidance of turbulence by aircraft in flight. The question of measuring the height of echoes observed by radar, which represents an index of storm activity is considered and the interpretation of echoes for different types of radar is discussed. The processing and transmission of radar information is discussed in detail and transmission of radar information to aircraft in flight is also considered. New techniques developed for radar observations are also presented. Author (ESRO)

N71-24423# Committee on Space Research (COSPAR), Paris (France).
COMMENTS ON THE OBSERVING AND DATA PROCESSING SYSTEMS FOR FGGE, AS GIVEN IN GARP PUBLICATION NO. 3
Feb. 1970 46 p Presented at the GARP Planning Conf., Brussels, 16 - 20 Mar. 1970
Avail: NTIS

A discussion and further comments on the design of the GARP global observing network and its implementation is summarized. Among the details considered are the integration of the space-related observing subsystems into the global observing network, relationships between the space-based and conventional observations, processing of data to convert sensor signals into meteorological parameters, and planning aspects. Meteorological balloon impact damage to aircraft is also discussed. ESRO

N71-24438# GCA Technology Div., GCA Corp., Bedford, Mass.
ROCKETBORNE PHOTOMETER INVESTIGATION OF NOCTILUCENT CLOUDS Final Report, 1 Jun. 1968–1 Feb. 1971
Leslie G. Smith Feb. 1971 48 p refs
(Contract F19628-68-C-0374)
(AD-719005; GCA-TR-70-10-A; AFCRL-71-0005) Avail: NTIS CSCL 20/6

The design, construction, testing and flight performance of a rocket-borne dual-photometer system for investigation of the aerosol particle distribution in a noctilucent cloud is described. One photometer is mounted with the axis of the field of view parallel to the spin axis of the rocket. This photometer is equipped with a polarizer and observes the degree of polarization of the cloud at a particular scattering angle and at a specified wavelength (3750A). The second photometer is oriented at 60 degrees to the spin axis. The intensity of the scattered light is observed over a wide range of scattering angle at a wavelength of 5750A. (Author) GRA

N71-24439# Danish Meteorological Inst., Copenhagen.
PHENOLOGICAL RESEARCH IN GREENLAND Final Technical Report, 1964–1970
Ingolf Sestoft May 1970 30 p refs
(Contract DA-91-591-EUC-3341)
(AD-719720; ARDG(E)-E-948) Avail: NTIS CSCL 4/2

The report contains a study in phenology. It has been carried out under the cooperative auspices of the Danish Government and the U.S. Armys European Research Office. In this, study was made of the correlation between the life cycles of certain Arctic plants, especially planted in S.W. Greenland, and the prevailing meteorological and climatic factors and conditions obtaining there. The objective was to determine to what extent such conditions may be ultimately predicted from observations of plant growth alone. Although the period of years spanned (1964-1970) is too short to draw firm conclusions, tentative correlations are drawn and set forth in the report. Author (GRA)

N71-24441# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN OPTIMUM MODEL WITH A SMALL NUMBER OF VARIABLES FOR MULTILEVEL FORECASTING OF THE GEOPOTENTIAL FIELD
L. V. Rukhovets 9 Dec. 1970 29 p refs Transl. into ENGLISH from Tr. Simpozium po Chislennym Metodam Prognoza Pogody (Moscow), 24–29 Jun. 1963 p 98–115
(AD-719805; FTD-HC-23-672-70) Avail: NTIS CSCL 4/2

Many of the methods presently used for operational numerical weather forecasting cannot be used on more than a few levels. The difficulties in forecasting the fields of meteorological factors for a large number of levels are given and a two-parameter model is proposed for forecasting the geopotential fields. This model is based on optimum conventionalization, i.e. on a system which assures the best statistical accuracy in approximating the vertical profiles of the meteorological elements. Equations are derived which should be satisfied by the optimum function system. The author considered the statistical stability of optimum functions and found that those for daily changes in the geopotential are stable regardless of latitude or season, which applies as well to the optimum functions of the vertical profiles for the meridian and regional wind velocity components and those of daily geopotential changes are similar. The optimum functions were calculated for 20 days selected from the beginning of January, the middle of April, the beginning of July and the end of Octobe. Author (GRA)

N71-24442# Institut Royal Meteorologique de Belgique, Brussels.
ATMOSPHERIC POLLUTION, SMOKE, AND SULFUR DIOXIDE Monthly Bulletin, Oct. 1970 [POLLUTION ATMOSPHERIQUE, FUMEE ET ANHYDRIDE SULFUREUX Bulletin Mensuel, Octobre 1970]
1970 28 p In FRENCH and DUTCH Prepared jointly with Inst. d'Hyg. et d'Epidemiol.
Avail: NTIS

Data obtained at Belgian weather stations in October 1970 are tabulated. The air pollution apparatus is briefly described. ESRO

N71-24443# Institut Royal Meteorologique de Belgique, Brussels.
ATMOSPHERIC POLLUTION, SMOKE, AND SULFUR DIOXIDE Monthly Bulletin, Nov. 1970 [POLLUTION ATMOSPHERIQUE, FUMEE ET ANHYDRIDE SULFUREUX Bulletin Mensuel, Novembre 1970]
1970 28 p In FRENCH and DUTCH Prepared jointly with Inst. d'Hyg. et d'Epidemiol.
Avail: NTIS

Data obtained at Belgian weather stations in November 1970 are tabulated. The air pollution aparatus is briefly described. ESRO

N71-24467 World Meteorological Organization, Geneva (Switzerland). Joint Organizing Committee for GARP.
THE PLANNING OF THE FIRST GARP GLOBAL EXPERIMENT
Oct. 1969 56 p *Its* GARP Publ. No. 3
Copyright. Avail: Issuing Activity

A proposal is reviewed for the first GARP global experiment to be conducted during a 12 months period, and which will study the atmospheric circulation and physics in the stratosphere and troposphere. The period would be 1974–1975 and the observational network would be composed of both surface and upper-air stations such as geostationary satellites and balloons. A discussion of the expected outcome of the experiment is included together with some of the techniques to be used in the determination of the atmospheric parameters and data acquisition. Implementation problems are also considered. ESRO

N71-24468 World Meteorological Organization, Geneva (Switzerland).
IMPLEMENTATION OF WORLD WEATHER WATCH. Status Report No. 3
Jul. 1970 147 p
Copyright. Avail: Issuing Activity

The status and implementation of the World Weather Watch Global Observing System (GOS) is presented. The present situation is summarized and the improvements expected by the end of 1971 are given together with the methods of improvement. The implementation of the various components of GOS are considered and global and regional data are presented in tabular form. ESRO

N71-24469 World Meteorological Organization, Geneva (Switzerland). Joint Organizing Committee for GARP.
THE PLANNING OF GARP TROPICAL EXPERIMENTS
Jan. 1970 94 p *Its* GARP Publ. No. 4
Copyright. Avail: Issuing Activity

The place of tropical experiments within the GARP tropical sub-program with reference to the overall objectives of GARP are discussed. The evolution of ideas concerning the need for such experiments and their characteristics is briefly reviewed. A new

classification of tropical disturbances is presented and the observational network is described. Author (ESRO)

N71-24484# Meteorologisches Observatorium, Hohenpeissenberg (West Germany).
RESULTS OF THE SPECIAL PLUVIOGRAPH NETWORK IN 1970 [ERGEBNISSE DES REGENSCHREIBER-SONDERNETZES IM JAHRE 1970]
Dec. 1970 55 p In GERMAN *frs* Sonderbeobachtungen des Meteorol. Obs. Hohenpeissenberg No. 11
Avail: NTIS

Tables are presented covering rainfall data from a region in Bavaria (Germany). The following values are given: diurnal precipitation, maximum rainfall during one hour for each day, and maximum rainfall during 10 minutes for each day. ESRO

N71-24485# Air Weather Service, Scott AFB, Ill.
INTERIM INSTRUCTIONS FOR THE USE OF THE NATIONAL METEOROLOGICAL CENTER AIR POLLUTION POTENTIAL (APP) PRODUCTS
Valentine J. Descamps Feb. 1971 26 p refs
(AD-718966; ETAC-TN-71-1) Avail: NTIS CSCL 4/2

The report furnishes interim instructions and guidance to Air Weather Service (AWS) personnel in the understanding and use of the National Meteorological Center (NMC) Air Pollution Potential products. The NMC products are being transmitted over COMET III circuitry and FOFAX to the AWS detachments for their use in providing guidance to Base Pollution Control Officers. The report furnishes explanation of terms, application of the messages to forecast preparation, and guidelines for use in tailoring the general information furnished by NMC to local installation requirements. Author (GRA)

N71-24968 Cornell Univ., Ithaca, N.Y.
TURBULENT DIFFUSION BY FORCED CONVECTION
Gour-Tsyh Yeh (Ph.D. Thesis) 1969 140 p
Avail: Univ. Microfilms Order No. 70-8683

Evaporation and heat transfer were considered as phenomena of turbulent diffusion into a turbulent air flow over a water surface. The turbulent diffusion equations describing the heat and the mass transfer in the lower atmosphere were derived. A numerical scheme was developed to solve the mass transfer equation under appropriate boundary conditions. It was found that forward diffusion can be neglected and that the assumption of the power laws for the wind profile and turbulent diffusivity is valid provided a suitable is made for the parameters of the stability of the roughness. It was found that the evaporation and, as a bonus, the water surface temperature depend, inter alia, on the specific humidity of the air, on the wind velocity, and on the difference between the energy balances of the water surface and the surrounding ground. In winter, the water surface temperature is higher than the air temperature so that evaporation is increased and vice versa in summer. It was further found that Bowen's ratio is not a constant but varies in the downwind direction. Dissert. Abstr.

N71-25027 Florida State Univ., Tallahassee.
A SPECTRAL MODEL OF THE WINTER STRATOSPHERE
John Howard Clark (Ph.D. Thesis) 1969 177 p
Avail: Univ. Microfilms Order No. 70-11106

A numerical model is developed to study the winter stratospheric circulation. The quasi-geostrophic formulation of the equations of motion is used. Radiative effects include solar absorption by ozone and a Newtonian approximation in the infrared cooling. Ozone is treated as a separate independent variable with its photochemical sources and sinks described according to the Chapman theory. Joint radiative-photochemical dissipation of upper stratospheric temperature disturbances is shown to strongly inhibit otherwise baroclinically unstable disturbances from developing. Downward-propagating spontaneous high-latitude minor warmings occur which are related to increased forcing of the stratosphere by the troposphere. Rapid unstable nonlinear exchanges of kinetic energy initiate these warmings in the upper stratosphere. Dissert. Abstr.

N71-25055# Army Foreign Science and Technology Center, Charlottesville, Va.
OPTICAL PROPERTIES OF CLOUDS [OPTICHESKIE SVOISTVA OBLAKOV]
E. M. Feigelson 7 Jul. 1970 16 p refs Transl. into ENGLISH from Kosmich. Issled. Akad. Nauk SSSR (Moscow), v. 2, no. 3, 1964 p 455–461
(AD-719603; FSTC-HT-23-993-70) Avail: NTIS CSCL 4/2

A brief survey of the progress of study on optics of clouds is given. Primary attention is paid to theoretical work on transfer of radiation in clouds which determine principles of reflection and transmission of radiation by clouds without regard to the effect of extracloud atmosphere. Author (GRA)

N71-25056# Army Foreign Science and Technology Center, Charlottesville, Va.
ACCURACY IN DETERMINING THE HEIGHT OF A RADIOSONDE BY USING A TELEMETRIC ATTACHMENT TO MALAKHIT RADIOTHEODOLITE AT AEROLOGICAL STATIONS OF THE HYDROMETEOROLOGICAL SERVICE OF THE UZBEK SSR [O TOCHNOSTTOPREDELENIYA VYSOTY RADIOZONDA DALNOMERNOI PRISTAVKOI RADIO TEDDOLITA MALAKHIT NA AEROLOGICHESKIKH STANTSIYAKH UGMS UZOSR]
S. A. Budarina 3 Jun. 1970 23 p refs Transl. into ENGLISH from Tr. Sredneaz. Nauchno Issled. Gidmeteorol. Inst. (USSR), no. 46, 1967 p 156–169
(AD-719629; FSTC-HT-23-255-70) Avail: NTIS CSCL 4/2

Cited in this article are the results of an altitude comparison based on a reading of a radiosonde pressure unit, and calculated by measuring the slant range with a range-finding, attachment to a malachite radio theodolite. The relationship between the altitude divergence and the ballon coordinates, the sheltered location of the horizontal site and the characteristics of the subjacent media has been established. The results of special base-line observations were used to calculate the systematic and mean square errors in altitude, made by every measuring means, using P. F. Zaichikovs triple control method. GRA

N71-25081# Hebrew Univ., Jerusalem (Israel). Dept. of Meteorology.
NUMERICAL STUDIES OF PLANETARY CIRCULATIONS IN A MODEL ATMOSPHERE Final Scientific Report, 1 Aug. 1967–28 Feb. 1970
Abraham Huss Mar. 1970 240 p refs
(Grant AF-EOAR-46-67)
(AD-719867; AFCRL-70-0681) Avail: NTIS CSCL 4/2

A sequence of numerical experiments was performed modelling general features of the planetary circulation over a limited region. In the first experiment the results obtained from a primitive equation 2 level model are compared with the results of a geostrophic 2 level model. The equations were integrated over a Beta-plane with two lateral walls in the north and in the south. In the second experiment the results of a 3 level geostrophic model are compared with those of a 2 level geostrophic model. In the third experiment the smoothing effects of a lateral viscosity term are investigated and compared with the smoothing effect of the Matsuno approximation, of the time derivative. In the 4th experiment the spread of radon in a model atmosphere is investigated schematically, the source of the radon being located in the lower boundary. Author (GRA)

N71-25079*# Environmental Research and Technology, Inc., Waltham, Mass.
INTERACTION MODEL OF MICROWAVE ENERGY AND

ATMOSPHERIC VARIABLES
Norman E. Gaut and Edward C. Reifenstein, III 20 Apr. 1971 236 p refs
(Contract NAS8-26275)
(NASA-CR-61348) Avail: NTIS CSCL 04B

Results are presented for a study of the effects of water vapor, liquid water, and ice upon radiative transfer processes at microwave frequencies and in far infrared. The fundamental processes by which these species interact with microwave energy are discussed, and their statistics analyzed in terms of their application to a range of remote sensing problems. Theoretical expressions for the water vapor absorption coefficient at microwave frequencies are reviewed, and an efficient computer-oriented algorithm is presented for its computation. The Mie theory is reviewed, and the unit-volume effects of typical liquid water and ice cloud distributions over the spectral range from 10 cm to 10 microns are examined. Characteristics of the two-dimensional distributions of water vapor, liquid water, and ice in the atmosphere were collected on planetary, synoptic, meso-, and microscales, and are examined in terms of remote sensing applications. Extreme values of each are established as a function of scale size and related to the attenuation and noise energy produced and their fluctuations in time. Author

N71-25105# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRUCTURE OF HELIOCLIMATIC RELATIONS AND THEIR USE IN LONG AND SUPERLONG RANGE FORECASTING
V. N. Kupetskiy 28 Oct. 1970 16 p refs Transl. into ENGLISH from Izv. Vses. Geogr. Obshchestvo (USSR), v. 101, no. 4, 1969 p 289–295
(AD-719768; FTD-HT-23-608-70) Avail: NTIS CSCL 4/2

Solar activity, expressed by cycles of different orders, exerts an enormous influence on processes in the earths troposphere, in each specific physiographic region creating definite climatic conditions with a definite variability. The mechanism of interaction between solar activity and the earths atmosphere is still unknown. Accordingly, the problem of long-range heliophysical forecasting must be solved in the opposite direction, considering any climatic element as the final result of a complex mechanism of solar-terrestrial interaction. Under various physiographic conditions and in each specific year the mechanism of helioclimatic interactions is manifested differently, in dependence on the height of the maximum of the 11-year cycle and its evenness. Each even and odd 11-year cycle forms double 22-year cycle making up the principal 44-year cycles, having the most regular alternation of high and low values. Helioclimatic relationships are determined by using the method of superposing of epochs. Author (GRA)

N71-25136# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOME PROBLEMS IN AUTOMATIC PROCESSING OF HYDROMETEOROLOGICAL INFORMATION
E. M. Dobryshman 19 Nov. 1970 15 p refs Transl. into ENGLISH from Tr. Gidrometeorol. Nauchno Issled. Tsentr SSSR (USSR), no. 1, 1967 p 3–9
(AD-719837; FTD-HT-23-567-70) Avail: NTIS CSCL 4/2

The paper deals with the characteristics of the primary meteorological information and the algorithm of the initial processing. The rate of incoming information to the processing centers varies widely, as are the total number of messages in a given observation period. Nearly ten types of information reach the central stations. The information is initially sorted in accordance with its nature: synoptic, aerological, hydrological, agrometeorological. In the next stage the information is processed in accordance with its other characteristics, such as time, date, geographical point of observation, etc. The second stage can lead to a creation of an information retrieval system. To be fully useful such systems must satisfy the following requirements: ability to sort the data accurately in accordance with a given characteristic; summaries; distinctive separation between the telegrams, summaries, and information retrieval. Author (GRA)

N71-25149# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYNOPTICO-CLIMATOLOGICAL AND HELIOGEOPHYSICAL LONG TERM WEATHER FORECASTING
T. V. Pokrovskaya 3 Dec. 1970 341 p refs Transl. into ENGLISH of the publ. 'Sinoptiko-Klimatologicheskiye i Geliogeofizicheskiye Dologosrochnyye Prognozy Pogody' Leningrad, Gidrometeorol., 1969 p 1–254
(AD-719760; FTD-MT-24-139-70) Avail: NTIS HC $6.00/MF $0.95 CSCL 4/2

Methods of forecasting of monthly and seasonal mean values of climatological elements are discussed in terms of synoptic climatology. Problems in adjacent fields are mentioned. The author gives a review of works carried out in this field and offers her own technique for forecasting of monthly temperature anomalies over the European territory of the U.S.S.R. The first six chapters of Part I of the book represent a review of the investigations of the fundamental problems of the forecast of monthly and seasonal anomalies of the climatological elements. According to the author, such problems are the following: use of teleconnections, analysis of the influence of the earths surface on the formation of the circulation processes and anomalies of the meteorological regime, comprehension of the cyclic fluctuations. Besides the general statements, T. V. Pokrovskaya discusses rather in detail the problems of the southern oscillation of the atmospheric pressure and the quasi-biennial stratospheric and tropospheric fluctuations. Author (GRA)

N71-25150# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NUMERICAL METHODS OF FORECASTING THE METEOROLOGICAL ELEMENTS
G. R. Zakharov et al 8 Dec. 1970 112 p refs Transl. into ENGLISH from Tr. Gidrometeorol. Nauchno Issled. Tsentr SSSR (USSR), no. 29, 1968 p 1–76
(AD-719813; FTD-MT-24-148-70) Avail: NTIS CSCL 4/2

Results of research in forecasting the baric field, wind, trajectory of air particles, and movements of typhoons using the solution of hydrodynamic equations are given. Attention is paid to questions of finite-difference approximation of equations and stability of the solution. The problem of filtration of meteorological noises in the numerical forecast is considered. Author (GRA)

N71-25259*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MRIR OBSERVATIONS OF JET STREAMS
Vincent V. Salomonson *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 15–18 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 04A

Nimbus 2 infrared radiometer observations of southwesterly subtropical jet streams over the United States are examined. Equivalent blackbody temperature fields associated with the jet streams are analyzed on Mercator map base for their characteristic patterns. The predominant feature in these patterns is a band of warmer temperatures to the rear of the wind speed maximum and to the left of the jet wind stream core. It is concluded that patterns of equivalent blackbody temperatures can be used to locate regions of southwesterly jet stream flows in the subtropics and for estimating position and magnitudes of maximum wind speeds. G.G.

N71-25260*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OPTICAL PROPERTIES OF CLOUDS

Warren A. Hovis *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 19-22 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 04B

Remote measurements of optical cloud properties by aircraft mounted spectrometers are described. Cloud reflectance measurements in the solar infrared region show that a two channel radiometer with bands centered at 1.7 microns and 2.1 microns can discriminate cloud type and determine to some degree the size of cloud particles. A third channel centered at 1.6 microns is able to distinguish between jet contrails and natural clouds. G.G.

N71-25261*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A COMPARISON BETWEEN OBSERVED WINDS AND CLOUD MOTIONS DERIVED FROM NIMBUS 2 HRIR MEASUREMENTS
William Shenk *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 23-26 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 04B

Two adjacent orbits from orbiting polar satellites were used to ascertain cloud motion between views of the clouds in 108 minute periods. Nimbus 2 infrared radiometric data and constant pressure charts were used to determine actual wind speeds for comparisons with cloud motions. Computed cloud motions agreed fairly well with observed wind speeds as determined from constant pressure charts along the abcissa within five to ten knots. G.G.

N71-25262*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SIMULATED GARP STUDIES
Robert Jastrow *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 27-33 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 04A

A computer program is developed to calculate winds from temperature data obtained by Nimbus 3 infrared vertical sounders. A history tape is generated that approximates the initial conditions for the equations of motion and the associated atmospheric state equations. Simulation calculations for a 100 day physical model, using data from two polar orbiting satellites 90 deg apart show good agreement with the real time input planned for the Global Atmospheric Research Program (GARP) experiment. G.G.

N71-25263*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A NEW UV ABSORBING LAYER NEAR 50 km
Arlin J. Krueger *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 34-37 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 04A

Filtered radiometer data on atmospheric ozone taken during parachute descent are reported. Three separate optical filters were used to make measurements on ozone concentrations in a range up to 60 km. Calculated results for an ultraviolet absorbing ozone layer differed markedly from observed intensity gradients at wavelengths near 3000 A; this effect is attributed to metastable excited oxygen states rather than to a permanent atmospheric constituent. G.G.

N71-25265*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DIURNAL PHASE ANOMALY IN THE EARTH'S UPPER ATMOSPHERE
Sushil Chandra *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 41-44 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 04B

Discrepancies between the phase and the diurnal amplitude of the thermospheric temperatures inferred from satellite drag and Thompson backscatter results are discussed. It is shown that the introduction of a dynamic diffusion concept for computing the temperature from density leads to a reasonable agreement between both sets of observational data and that the assumption of an invariant boundary is not valid. G.G.

N71-25266*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EFFECT OF ATMOSPHERIC WINDS ON THE POSITIVE O-POSITIVE H TRANSITION LEVEL
Henry C. Brinton *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 45-48 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 04B

Altitude data at which the dominant ionospheric constituent changes from O+ to H+ are analyzed by plotting altitude variations of the transition levels as functions of geomagnetic latitudes at 3 longitudes using Explorer 32 ion mass spectrometer data. It was found that the asymmetry of the sun in the magnetic field reference frame invoked the asymmetry of the neutral winds which in turn caused asymmetry in observed transition levels. Obtained hydrogen and oxygen ion concentration profiles show that the transition level was several hundred kilometers lower in the south than in the north at the investigated longitude. G.G.

N71-25332*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A TROPICAL WIND TRACKING TECHNIQUE
Albert E. Arndt *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 316-319 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 04B

A tropical wind experiment is reported that monitors and maps wind fields at three altitudes by randomly transmitting data to a satellite from a global equatorial system of balloons. Each of the free floating balloons carries a transmitting system for temperature and pressure signals and a carrier signal for identification and tracking. Results from this study confirm the feasibility of the incoherent random transmission technique for receiving data and for tracking a large number of balloon platforms. G.G.

N71-25412# Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia).
DIVISION OF METEOROLOGICAL PHYSICS Annual Report, 1969-1970
1970 43 p
Avail: NTIS

A summary is presented of research in the basic physical processes which control weather and climate. Areas discussed include: dynamical and synoptic meteorology, radar meteorology, upper atmosphere, micrometerology, atmospheric and terrestrial radiation, and agricultural meteorology. F.O.S.

N71-25424*# Wisconsin Univ., Madison. Space Science and Engineering Center.
BALLOON-BORNE RADIO ALTIMETER AND SATELLITE METEOROLOGICAL DATA APPLICATIONS Quarterly Report, 1 Sep.-31 Dec. 1970
V. E. Suomi 1970 12 p refs
(Contract NAS5-11542)
(NASA-CR-118337) Avail: NTIS CSCL 04B

The research for the period September 1 to December 31, 1970 is reported. Major reporting areas include: (1) miniaturizing the balloon borne radio altimeter, (2) correlating the cloud brightness with meso to subsynoptic scale rainfall intensity and amount in the mid-latitude as well as in the tropical disturbance regime, (3)

the feasibility of an inexpensive real-time communication of ATS enhanced pictures to data sparse remote places in the tropics, (4) some applications of satellite data on the study of atmospheric dynamics, and (5) a feasibility study on the ATS time domain data access systems. Author

N71-25507+ Japan Meteorological Agency, Tokyo.
AEROLOGICAL DATA OF JAPAN: DEW POINT TEMPERATURE, ATMOSPHERIC ELECTRICITY, LONG WAVE RADIATION, 1966–1967
1970 223 p refs
Avail: NTIS

Tabulated upper air data obtained over Japan by special radiosondes for dew point, atmospheric electricity, and long wave radiation fluxes are presented for 1966 and 1967. Descriptions of the radiosondes are included. F.O.S.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N71-24369# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
NAVIGATION EQUIPMENT, AUTOMATIC Final Report
17 Dec. 1970 26 p refs
(AD-719096; MTP-6-3-205) Avail: NTIS CSCL 17/7

Procedures are identified for service test evaluations of Army aircraft navigation systems. Author (GRA)

N71-24451# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
APPROACH SYSTEMS (TERMINAL AIR TRAFFIC CONTROL FACILITY) Final Report
15 Dec. 1970 24 p refs
(AD-719104; MTP-7-3-066) Avail: NTIS CSCL 17/7

A basic guide for preparation of test plans for terminal air traffic control facility equipment is given. Provides for testing shelters containing ground to air communication, acquisition equipment, and meteorological equipment. Compatibility of the shelter with associated transportation media are considered. Author (GRA)

N71-24555# Litchford Systems, North Port, N.Y.
NEW DEVELOPMENTS IN SCANNING BEAM LANDING GUIDANCE SYSTEMS, PART 2 Final Annual Report
George B. Litchford Wright-Patterson AFB, Ohio AFFDL Dec. 1970 255 p refs
(Contract F33615-69-C-1110)
(AD-718972; L-AF-04-Pt-2; AFFDL-TR-69-107-Pt-2; AR-2) Avail: NTIS CSCL 17/7

Design details are given of a CW microwave scanning-beam system operating at C and Ku bands. Many of the available design options are noted that apply to the solution of certain engineering problems. One of the virtues of the plan is that several options exist for rapid validation of all critical matters. Consequently the total risks, both economically and technically, now appear much lower than previously. Possible designs of angle-data modulation, dual-band receivers, angle-data processors, etc., are reviewed as are several validation tests and experiments now needed to tie down engineering parameters before a firm national signals-in-space standard can be approved. The important advances in the last year toward planning a national system for aircraft landing in all environments suited to all physical types and operations of aircraft are identified. Author (GRA)

N71-24626*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SINGLE AXIS REFERENCE STRAPDOWN INERTIAL MEASURING UNIT
Charles E. Lee 1 Mar. 1971 56 p ref
(NASA-TM-X-64586) Avail: NTIS CSCL 17G

The design, development, and test of single-axis reference (SAR) strapdown inertial measurement units (IMUs) are described, and the theory and operation of the SAR IMU are presented. Designs and testing of the accelerometers are discussed. Laboratory, sled, and mobile tests of the IMU system (including the computer) are outlined. Future plans, which include design, development, and testing dodecahedron SAR strapdown IMUs and new gyro concepts for possible application on the space shuttle vehicle, are delineated. Author

N71-24880*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OPERATIONAL CONSIDERATIONS FOR THE USE OF LORAN-C SKYWAVES FOR TIME SYNCHRONIZATION
Wilfred E. Mazur, Jr. Apr. 1971 52 p refs
(NASA-TM-X-65515; X-573-71-148) Avail: NTIS CSCL 17G

The capability of near-world wide time synchronization of Loran-C systems is discussed. Night time sky-wave reception of up to 15,400 Km has been achieved with time synchronization to better than 25 microseconds. Good results at such long distances, however, put much demand on receiver performance and operator technique. Many of the common problems and mistakes which can arise in Loran-C timing, and some solutions which have proven most effective are presented. Author

N71-24948* National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
SATELLITE AIDED VEHICLE AVOIDANCE SYSTEM Patent
Ernest R. Steele, inventor (to NASA) Issued 22 Dec. 1970 (Filed 28 Mar. 1969) 19 p Cl. 343-112; Int. Cl. G01s5/02
(NASA-Case-ERC-10090; US-Patent-3,550,129; US-Patent-Appl-SN-811542) Avail: US Patent Office CSCL 17G

A method and an apparatus for warning aircraft pilots of the proximity of another aircraft are detailed. The apparatus comprises a system including a satellite for transmitting a synchronizing signal and means onboard the aircraft for receiving said synchronizing signal. Means are also included onboard said aircraft for generating a response signal in response to said synchronizing signal and for opening a gate upon the receipt of said synchronizing signal for receiving said response signal. The gate is maintained open for a predetermined period of time that establishes a threat detection zone so that a response signal from another aircraft passes through the gate only if the response signal is received during the predetermined period of time. The received response signal is applied to an indicator to indicate the proximity of the other aircraft or is used to compute the threat of collision and derive a display of a suitable avoidance maneuver.
Official Gazette of the U.S. Patent Office

N71-24973# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPTIMUM PARAMETRIC LAWS OF SPACECRAFT DESCENT CONTROL
V. M. Ponomarev et al 8 Dec. 1970 25 p refs Transl. into ENGLISH from Proc. of Guidance and Control in Space, Intern. Federation of Autom. Control, 4th Congr., Warsaw, 16–21 Jun. 1969 (USSR), 1969 p 39–51
(AD-719795; FTD-MT-24-252-70) Avail: NTIS CSCL 22/3

The random disturbances which act on a spacecraft in the atmosphere as well as the divergence of initial conditions of spacecraft entry into the atmosphere cause considerable dispersion of the coordinates of its landing point, particularly at entry speeds beyond orbital velocity. Under these conditions, the utilization of traditional linear laws for stabilizing the center of mass of the spacecraft to isochronous variations of parameters of programmed travel may not guarantee pinpoint accuracy. This forces us to turn to other, more effective methods of control. The presence aboard a spacecraft of a navigation unit and a computer, with the aid of which it is possible to continuously determine parameters of motion and to shape the control signals from rather complex algorithms, facilitates the use of parametric control programs, when the programmed trajectory is assigned depending upon a certain kinematic or dynamic trajectory parameter. Author (GRA)

N71-25135 University of Southern Calif., Los Angeles.
AIM POINT STRATEGIES FOR QUARANTINED INTERPLANETARY NAVIGATION
Thomas Holman Thornton, Jr. (Ph.D. Thesis) 1970 227 p
Avail: Univ. Microfilms Order No. 70-11391

Interplanetary navigation is considered when the aim points of required guidance corrections must be biased in order to satisfy a planetary quarantine constraint. The navigation problem is that of estimating the state of a moving vehicle. For interplanetary travel, this problem can be extended into knowing the destination to provide flight path corrections to the estimated state of the spacecraft. The objectives of the study are (1) to develop an inverse to the planetary quarantine integral, (2) to derive optimum aim point selection strategies for interplanetary navigation when the aim points are constrained by a planetary quarantine, (3) to develop a guidance maneuver simulation technique more efficient than the usual Monte Carlo technique, and (4) to relate aim point selection strategies to mission guidance objectives for a sequence of two guidance corrections. Dissert. Abstr.

N71-25331*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE INTERROGATION, RECORDING, AND LOCATION SYSTEM EXPERIMENTAL RESULTS
Charles E. Cote *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 311-315 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 17G

The IRLS system is a satellite technological experiment designed to demonstrate the feasibility of position determination and scientific data collection from remote instrumented platforms deployed on a global scale. Addresses from platforms expected in view are programmed into the satellite on an orbit-by-orbit basis from a ground station and interrogation commands are executed throughout the orbit at predetermined intercept times. Up to 28 channel data are collected simultaneously from each platform. Analyses of ranging and location data show that the ranging technique has performed according to design specifications; original location errors were substantially reduced by inserting updated orbital elements. G.G.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N71-24432# United Kingdom Atomic Energy Authority, Harwell (England).
EVACUABLE GLOVE BOX FOR THE HANDLING OF LIQUID SODIUM, AND APPARATUS FOR THE ANALYSIS OF CARBON IN SODIUM AND OTHER METALS
R. Ainsley, P. M. Holroyd, G. Long, and L. P. Stratton Dec. 1970 25 p refs
(AERE-R-6338) Avail: AEC Depository Libraries

A stainless steel dry box constructed for the safe and contamination-free handling of liquid sodium is described and operating experience summarized. Operations are carried out with the box either filled with high purity argon or evacuated. The box is designed to permit easy modification and is suitable for the handling of other highly reactive materials. Also described is the apparatus used for the analysis by combustion of total carbon (as natural carbon and/or labelled with C-14) in sodium and other metals (iron, nickel, zirconium), and the method and equipment used to determine the nature and quantity of carbonaceous species present in sodium. Author (NSA)

N71-24471# Kernforschungsanlage, Juelich (West Germany). Inst. Fuer Material und Festkoerperforschung.
THE PRECIPITATION OF VANADIUM OF UO2 SPHERES FROM THE GAS PHASE [DIE ABSCHEIDUNG VON VANADIN AUF UO-2 KUGELN AUS DER GASPHASE]
Helga Schneider and Dieter Schoenwald Oct. 1970 19 p refs In GERMAN
(KFK-1292) Avail: AEC Depository Libraries

A method is described to provide for fluidized bed coating of spherical UO2 with metallic vanadium having a chlorine content <0.01%. By reduction of VCl4 above 950 C in the presence of hydrogen, up to 45 vol.% of vanadium was vapor deposited on batches of 30 to 50 g of UO2 spheres. The coatings had bright surfaces, were of good quality, and were dense and uniform. The coated particles were used for fabrication of UO2/V cermets of ideal structure and could be packed satisfactorily by isostatic hot compaction. Author (NSA)

N71-24472# Fiat S.p.A., Turin (Italy).
NUCLEAR FUEL WITH BURNABLE POISON. PART 2: PREPARATION AND OUT OF PILE EVALUATION OF Gd2O3 POISONED UO2 PELLETS Topical Report, 1 Jan. 1969-31 May 1970
G. Abate-Daga, I. Amato, and G. Grappiolo Nov. 1970 40 p refs
(EUR-4551) Avail: AEC Depository Libraries

Gd2O3 microspheres about 500 microns in diameter were molybdenum coated by metal vapor deposition in a fluidized bed. The coating thickness was maintained in the range 25 to 30 microns. The optimum density of gadolinia microspheres, in order to maintain coating integrity at high temperature, was in the range 85 to 90% of theoretical density (TD). UO2 pellets poisoned with 1200 ppM of Gd2O3 were obtained at about 95% TD. Tests performed at high temperature both under gradient and isothermal conditions showed an acceptable behavior of molybdenum coated gadolinia microspheres in UO2 pellets. Author (NSA)

N71-24501*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NATIONAL SYMPOSIUM ON DEVELOPMENTS IN IRRADIATION TESTING TECHNOLOGY
1969 786 p refs Symp. held at Sandusky, Ohio, 9-11 Sep. 1969 Prepared in cooperation with AEC, Washington, D.C.
(NASA-TM-X-67172; TID-4500; CONF-690910) Avail: NTIS HC $9.00/MF$0.95 CSCL 18D

Papers are presented on capsule design, environmental control and determination, postirradiation examination, fabrication, and operating experience. For individual titles, see N71-24502 through N71-24552.

N71-24502*# General Electric Co., Cincinnati, Ohio.
THE INFLUENCE OF NEUTRON SPECTRUM ON HELIUM ATOM GENERATION IN STAINLESS STEELS
J. Moteff *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 3–23 refs (See N71-24501 13-22)
(Contract AT(40-1)-2847)
Avail: NTIS HC $9.00/MF $0.95 CSCL 18I

A study of the effects of helium generation resulting from neutron irradiation which increases in importance as new theories of void formation and subsequent embrittlement develop is presented. Comparisons between calculated and directly measured quantities of helium are now in progress. Effective spectrum averaged cross sections or empirical differential cross sections (using cross section unfolding programs) were obtained by irradiating high purity elements in several different reactor facilities. Correction factors to the fission spectrum averaged cross sections are proposed which comprise an interim method for calculations of the helium atoms generated in various fast spectrum facilities. NSA

N71-24503*# Idaho Nuclear Corp., Idaho Falls.
FATIGUE SPECIMEN CAPSULES, EBR-2 MARK B-7 SUBASSEMBLY
J. M. Beeston, M. W. Ellingford, and C. R. Brinkman *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 24–37 refs (See N71-24501 13-22)
(Contract AT(10-1)-1230)
Avail: NTIS HC $9.00/MF $0.95 CSCL 18I

Design, fabrication, and operating experience from irradiation of fatigue specimen capsules in an EBR-2 MARK B-7 subassembly are discussed. The effect of specimen size and shape, and of program criteria on the design is evaluated. Heat transfer considerations that influence the design are reviewed. The assembly to meet quality assurance of parts and performance, and the operating experience from 2864 MWd in EBR-2 on one subassembly are given. The operating temperature of the specimens in sodium at 50 MW was about 400 C and in argon was 750 C. Author (NSA)

N71-24504*# Argonne National Lab., Ill.
CAPSULES AND SODIUM LOOPS USED IN ARGONNE NATIONAL LABORATORY REACTOR SAFETY EXPERIMENTS IN THE TREAT REACTOR
L. E. Robinson, R. Ivins, and C. E. Dickerman *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 38–51 refs (See N71-24501 13-22)
Avail: NTIS HC $9.00/MF $0.95 CSCL 18I

The development of radiation target cans for use in the TREAT facility is reviewed. Experimental facilities and equipment are described. Descriptions of the Mark 1 and Mark 2 in-pile Na loops for the TREAT facility are included. NSA

N71-24505*# Argonne National Lab., Ill.
USE OF THE THERMAL TREAT REACTOR FOR FAST REACTOR SAFETY STUDIES
C. E. Dickerman, R. O. Ivins, A. R. Rothman, and J. F. Boland *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 52–58 refs (See N71-24501 13-22)
Avail: NTIS HC $9.00/MF $0.95 CSCL 18I

Design parameters of the TREAT facility are discussed. Experimental facilities are described. NSA

N71-24506*# Argonne National Lab., Ill.
XENON TAGGING OF INSTRUMENTED FUEL CAPSULES FOR USE IN EBR-2
D. E. Walker, P. J. Halfman, and J. H. Sanecki *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 59–70 Sponsored by AEC (See N71-24501 13-22)
Avail: NTIS HC $9.00/MF $0.95 CSCL 18I

An instrumented subassembly for the EBR-2 is described. The sensors in the subassembly provide signals for: fuel-center temperatures up to 2000 C; cladding temperature; fuel-element internal pressure; Na inlet and outlet temperatures; Na flow rate; and neutron flux. The subassembly contains 19 elements and 22 instrument leads. To permit rapid and positive indication that the subassembly contains a failed or defected fuel element, each element is tagged by approximately 1 ml of a gas containing mixture of xenon isotopes to the He bond gas. The resulting gas mixture consists of approximately 14 vol % of Xe in He. If an element should fail, the tag gas would be liberated to the reactor's Ar cover gas where it would be detected. NSA

N71-24507*# Argonne National Lab., Ill.
INSTRUMENTED SUBASSEMBLY SYSTEM AND IN-CORE INSTRUMENT TEST FACILITY FOR EBR-2
E. Hutter, O. S. Seim, and A. Smaardyk *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 71–102 refs (See N71-24501 13-22)
Avail: NTIS HC $9.00/MF $0.95 CSCL 18D

The design parameters of the EBR-2 are reviewed. The control and loading systems are described. The design parameters for the instrumented subassembly are presented. The subassembly consists of 16 capsules containing Type 304 stainless steel clad UO2 fuel specimens and two capsules containing structural materials. NSA

N71-24508*# Argonne National Lab., Ill.
CHARACTERIZATION OF ADVANCED IRRADIATION TESTING VEHICLES FOR EBR-2
O. S. Seim, W. R. Ware, and E. Hutter *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 103–117 (See N71-24501 13-22)
Avail: NTIS HC $9.00/MF $0.95 CSCL 18D

Experimental facilities for the EBR-2 are described. Design parameters and illustrations are presented for various fuel elements involved in radiation testing experiments. NSA

N71-24509*# United Nuclear Corp., Elmsford, N.Y.
UNRESTRAINED SWELLING AND FISSION GAS RELEASE EXPERIMENTS
Michael H. Montgomery, Carl J. Grando, and Alfred A. Strasser *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 118–126 (See N71-24501 13-22)
Avail: NTIS HC $9.00/MF $0.95 CSCL 18I

Illustrations and design parameters of radiation target cans designed for swelling studies of mixed carbide fuels are presented. Operating conditions and experimental results are included. NSA

N71-24510*# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
ANALYSIS OF THE VALIDITY OF FAST REACTOR FUEL TESTS IN EXISTING TEST REACTORS
A. R. Olsen, R. B. Fitts, and C. M. Cox *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 127–150 refs Sponsored by AEC (See N71-24501 13-22)
Avail: NTIS HC $9.00/MF $0.95 CSCL 18I

The neutronic and thermal environments for a stainless steel-clad (U,Pu)O2 fuel rod operating in a typical proposed commercial fast reactor with test conditions currently available in both thermal and fast flux test reactors are compared. Calculations were performed to describe the cladding fluence, fuel radial power distribution, fuel and cladding temperature distributions, fuel restructuring, and fission product yields as functions of fuel burnup. The calculations indicate that properly designed and interpreted thermal flux experiments simulate the reference fuel operating conditions in terms of temperature distributions and average fission product yields. The EBR-II fast flux test simulation is, in general, quite good

except for difficulties arising from the relatively low flux in the reactor which leads to the use of fully enriched uranium to obtain the 16 kw/ft peak heat rate desired. Author

N71-24511*# Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research.

A REACTOR FACILITY FOR NEUTRON IRRADIATIONS AT TEMPERATURES RANGING FROM −193 C TO 725 C

R. G. Struss and C. W. Chen *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 153−156 refs (See N71-24501 13-22)

Avail: NTIS HC $9.00/MF $0.95 CSCL 18I

An experimental facility in the Ames Research Reactor is described which has a variable temperature in a fast neutron flux environment. The combination of using a flux converter in the reactor in conjunction with the temperature control in a cryostat is discussed. NSA

N71-24513*# Battelle Memorial Inst., Columbus, Ohio.

APPARATUS FOR MEASURING IN-PILE CREEP OF LMFBR CANDIDATE FUELS

R. A. Robinson and S. J. Basham, Jr. *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 165−183 refs (See N71-24501 13-22)

(Contract W-7405-eng-92)

Avail: NTIS HC $9.00/MF $0.95 CSCL 18I

The design and operation of an apparatus to obtain data on the compressive creep of ceramic fuel materials during irradiation are described. The specimen (UO_2 or UO_2-PuO_2) is fabricated in the shape of an annular cylinder to reduce temperature gradients caused by fission heating. A compressive load is applied to the specimen through a bellows-sealed, gas-actuated piston. Specimen temperatures are maintained by a resistance-wire heater. Axial creep of the fuel is measured by transmission of the motion through bellows-sealed probes that are linked to a variable-area-orifice, pnuematic displacement transducer. The equipment is designed to operate with fuel temperatures in the range 900 to 1300 C, stress levels of 3,000 to 12,000 psi, and fission rates ranging up to 2×10 to the 13th power fissions/cc-sec. Data are presented on the in-pile and out-of-pile creep characteristics of UO_2 specimens as measured in initial tests to check the operation of the equipment. Author (NSA)

N71-24515*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPACT 30 kw CIRCULATING HELIUM CAPSULE FOR FUEL ELEMENT TESTS IN NASA PLUM BROOK REACTOR

G. E. McDonald, H. A. Putre, M. C. Swanson, P. M. Finnegan, and L. Homyak *In its* Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 197−209 (See N71-24501 13-22)

Avail: NTIS HC $9.00/MF $0.95 CSCL 18I

A capsule has been endurance tested out of pile and two capsules have been tested in the Plum Brook Reactor. The capsule operates at pressures to 2500 psi, motor speed at 3000 rpm, flow rates to 0.09 lb He/sec, capsule wall temperatures to 1000 F, specimen powers to 30 kW with 180 F cooling water. Demonstrated out-of-pile life is at least 3000 hours. Fuel specimen surface heat fluxes of 2 kW/sq in. have been obtained in pile. The capsule is 18 feet long with 4.3 inch maximum OD and 2.875 OD in the test section. It is composed of a variable speed electric motor driven vane pump, concentric tube heat exchanger, and a fuel element test section. The capsule is made of modified commercially available parts. Provisions are made for 15 thermocouples. Pressure leads used for filling are also used to measure gas flow rate and monitor coolant gas for fission product leaks. A loss of coolant accident can be contained without reactor scram for specimen powers of 30 kW or less. Capsules are relatively inexpensive and can be discarded when the test is completed. Author (NSA)

N71-24516*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENT DESIGN STUDIES FOR FUEL PIN DEVELOPMENT

Ralph Stein, Len Homyak, and Robert DeFayette *In its* Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 210−220 (See N71-24501 13-22)

Avail: NTIS HC $9.00/MF $0.95 CSCL 18J

A mockup of a UN fuel pin proposed for a space power reactor was designed and tested in the NASA-ZPR-1 Reactor. The method used to simulate the UN and to measure the power gradients and power densities is described. Results are presented showing the effect of a Hf shield in reducing the power gradients. Author (NSA)

N71-24517*# California Univ., Livermore. Lawrence Radiation Lab.

CONCEPT FOR A GAS BUFFERED ANNULAR HEATPIPE FUEL IRRADIATION CAPSULE

J. D. Lee and R. W. Werner *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 221−247 Sponsored by AEC (See N71-24501 13-22)

(UCRL-50510) Avail: NTIS HC $9.00/MF $0.95 CSCL 18J

A nuclear fuel irradiation capsule capable of handling large (approximately 300 W/sq cm) and varying fuel specimen heat fluxes while inherently maintaining nearly constant specimen temperature was conceived and two bench models successfully tested using potassium and sodium as the working fluids. Test temperatures were in the 700 C range and heat source temperatures were preserved within + or − 15 C while undergoing factors of three changes in power. Author

N71-24518*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

IN-PILE GAMMA DOSIMETRY MEASUREMENTS WITH OXALIC ACID

J. L. Power *In its* Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 251−266 refs (See N71-24501 13-22)

Avail: NTIS HC $9.00/MF $0.95 CSCL 18I

The gamma dose rates in the NASA Research Reactor are measured. Concentrated oxalic acid (H_2Ox) was chosen as the only chemical gamma dosimeter both compatible with the lead-type capsule system to be used and capable of measuring the high gamma dose rates present. Experimental procedures and results are presented. NSA

N71-24520*# Battelle Memorial Inst., Columbus, Ohio.

CONTINUOUS MONITORING OF FISSION GAS RELEASE DURING IRRADIATION OF NUCLEAR FUEL SPECIMENS

L. L. Yarger, N. E. Miller, and J. W. Ray *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 281−295 (See N71-24501 13-22)

(Contract W-7405-eng-92)

Avail: NTIS HC $9.00/MF $0.95 CSCL 18I

Development of a system to continuously monitor fission gas release from the fuel during irradiation is described. The system consists of a null-balance pressure transducer attached directly to a clad fuel specimen in the capsule. Fission gases escaping from the fuel collect within the cladding and exert pressure on a diaphragm in the transducer. A balancing pressure is introduced on the other side of the diaphragm and the null-balance position of the diaphragm is detected by an electrical contact which is part of a detection circuit. Instrumentation is provided to monitor the balance pressure, and the fission gas temperature and pressure is correlated with the known fission gas generation rate to calculate the fractional release from the fuel. In addition to monitoring fission gas release, the system also provides information on cladding integrity. Cladding failure is detected as a large reduction in pressure while operating at essentially constant temperature. This system has been used successfully in two

irradiation experiments at fuel and cladding temperatures in excess of 1700 C. The data it provides on fission gas release have been used in conjunction with swelling data from neutron radiography to provide considerable insight into the phenomenology of the behavior of nuclear fuels during irradiation. Author (NSA)

N71-24521*# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THE MEASUREMENT OF INTERNAL PRESSURE BUILDUP IN FULL SIZED FUEL RODS DURING IRRADIATION
T. B. Burley *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 296-306 ref (See N71-24501 13-22)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18J

Full-sized PuO2-UO2 fuel rods were instrumented to monitor internal gas pressures and plenum gas temperature during irradiation in the PRTR. Performances of the instrumented fuel rods are described. Author (NSA)

N71-24524*# Douglas United Nuclear, Inc., Richland, Wash.
MEASURED ENERGY DEPOSITION RATES FOR VARIOUS NONFISSIONABLE MATERIALS IN A NUCLEAR REACTOR ENVIRONMENT
Paul J. Zimmerman *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 350-365 refs (See N71-24501 13-22)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18J

A calorimeter was designed which could be used to measure heat generation rates for many materials at relatively low cost utilizing existing facilities. The device was designed to operate in a horizontal test facility and measure heat generation rates from a few watts to several hundred watts. Since a large number of samples could be tested, materials with a wide range of specific physical characteristics were chosen. Materials were chosen to either satisfy a specific customer interest or to give data to aid in separation of heat generation into gamma and neutron contributions, respectively. Author

N71-24526*# Argonne National Lab., Ill.
OBSERVATION OF FUEL FAILURE BEHAVIOR DURING IN-PILE MELTDOWN TESTS USING HIGH SPEED PHOTOGRAPH AND A TRANSPARENT AUTOCLAVE
John J. Barghusen, Lawrence J. Harrison, Richard O. Ivins, and Lewis E. Robinson *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 378-400 refs Sponsored by AEC (See N71-24501 13-22)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18I

A study involving excursion accidents in water-cooled thermal reactors is described. Single fuel rod specimens in a transparent autoclave are subjected to destructive nuclear transients while being observed and photographed. The failure threshold energy and mechanism of failure of Zircaloy-clad UO2 fuel rods are analyzed. The TREAT facility was used for the testing program. NSA

N71-24527*# Douglas United Nuclear, Inc., Richland, Wash.
IRRADIATED FUEL EXAMINATION AND MEASUREMENT
K. B. Sowa *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 403-412 (See N71-24501 13-22)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18J

Optical comparator and hydraulic gaging methods for obtaining underwater dimensional measurements of irradiated fuel elements are described. The optical comparator consists of an above water, ground glass screen connected by an air tube to a lower projection lens and immersed projection lamp. The magnified profile of the fuel specimen is measured on glass screen. An advantage of the optical device is the ability afforded the operator to observe and avoid surface anomalies. The principles of hydraulic gaging are applied to obtain internal diameters of fuel elements with acceptable precision and low capital investment. The increase in back-pressure as the water jet nozzle approaches a plane surface is measured, and the signal pressure is sent through a hydraulic passageway to the readout system several feet away. The ability to purge dirt or loose film is an obvious advantage in obtaining repeatable measurements. Author

N71-24528*# Oak Ridge National Lab., Tenn.
PYCNOMETER, PROFILOMETER, AND LASER PUNCTURING FOR SPACE REACTOR FUEL CAPSULE EXAMINATION
S. E. Dismuke *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 413-419 Sponsored by AEC (See N71-24501 13-22)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18J

Development of apparatus to obtain data on bulk density of swollen and cracked space reactor fuel pellets and data from continuous diameter and profile measurements on 4-1/2 in. test capsules is described. Equipment to puncture these capsules for gas collection without cracking the capsule wall is also described. A pycnometer was developed to measure the bulk volume from which the bulk density of porous fuel pellets is determined in a hot cell. A profilometer is provided for in-cell measurement of the profile and diameter of small cylindrical specimens. A laser beam is used for cladding puncture. NSA

N71-24529*# Oak Ridge National Lab., Tenn.
TECHNIQUES AND APPARATUS FOR INSPECTION, HANDLING, AND ANNEALING HIGHLY RADIOACTIVE FUEL MICROSPHERES
M. T. Morgan and R. L. Towns *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 420-434 refs Sponsored by AEC (See N71-24501 13-22)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18J

Techniques and equipment have been developed for remote handling, inspecting, and annealing of coated nuclear fuel microspheres. The equipment is adapted for use in shielded glove boxes and includes a revolving microprobe stage with vibrator to turn particles over remotely, a suction pickup, wrist-action manipulators, a Geiger-Mueller tube probe, an induction-type annealing furnace, and a separate gas collection and analysis system. Author (NSA)

N71-24530*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POST IRRADIATION ANALYSIS OF HIGH TEMPERATURE, LOW BURNUP TUNGSTEN-UO2 TEST PLATES
L. L. Ball and D. W. Shelbley *In its* Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 435-445 refs (See N71-24501 13-22)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18J

Problems in determining fuel burnup of high temperature fueled plates were resolved by using W-184 as a thermal flux monitor. Methods for determining fission product releases from fueled test plates were evaluated. The use of fission product Cs-137 as a burnup monitor was also evaluated. Author (NSA)

N71-24531*# Bettis Atomic Power Lab., Pittsburgh, Pa.
DECAY HEAT GENERATION AND REMOVAL FROM FUEL TEST BUNDLES
H. F. Daugherty, R. M. Lieberman, and M. Doumas *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 446-465 refs (See N71-24501 13-22)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18I

Simplified calculational techniques have been developed for estimating the decay heat power levels for irradiated fuel specimens, as a function of operating heat flux and effective full power days of operation. The calculated decay heat values were

experimentally verified. Specimen surface temperatures have been measured in typical small test bundles exposed to stagnant air cooling. Author (NSA)

N71-24533*# Bettis Atomic Power Lab., Pittsburgh, Pa.
A SYSTEM FOR CALCULATION OF FISSION POWER IN IRRADIATION TESTS
Richard M. Lieberman *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 473–490 refs (See N71-24501 13-22)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18J

A system has been developed which will predict fission power for irradiation test fuel samples. The samples are irradiated in a relatively stable, standard environment. Within this environment test fission power is controlled. The effect of system variables on fission power, determined by neutron diffusion and transport theory, was reduced to a set of design curves. Effective neutron fluxes are found from these design curves. Time dependent nuclear depletion equations are then solved for the isotopic content of both fertile and non-fertile test fuel materials. The system has been verified in the ETR. Author (NSA)

N71-24536*# Idaho Nuclear Corp., Idaho Falls.
A MICROPROBE STUDY OF THE RETENTION OF THE FISSION GAS XENON IN IRRADIATED URANIUM FUELS DISPERSED IN ALUMINUM CLAD NUCLEAR REACTOR FUEL PLATES
W. F. Zelezny, G. W. Gibson, and M. J. Graber *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 516–532 refs (See N71-24501 13-22)
(Contract AT(10-1)-1230)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18J

A number of techniques to enable the examination of irradiated and highly radioactive materials by microprobe are described. A number of applications of these techniques for the location and identification of fission products in and around irradiated dispersion fuel particles are outlined, with special emphasis on a technique for the semiquantitative comparison of the proportion of the fission gas xenon, retained by UAl4 and U3O8 dispersion fuel particles. It was found that UAl4 retained xenon more effectively than U3O8 under irradiation at 125 C. It is believed that this technique could make a contribution in the study of fission gas (or other fission product) retention and migration in other fuel systems. Author (NSA)

N71-24538*# Atomics International, Canoga Park, Calif.
NEUTRON RADIOGRAPHIC INSPECTION OF IRRADIATED SNAP FUEL
O. R. Hillig *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 540–550 (See N71-24501 13-22)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18N

Post irradiation test samples of SNAP reactor fuel elements have been nondestructively examined using neutron radiography. The results of the neutron radiographic (N-ray) examinations have been correlated with measurements made using standard hot cell destructive testing. Fuel swelling, cracking, and decomposition were readily discernible in a series of N-ray tests. Further examination of the N-rays revealed that information was available to determine hydrogen content in the uranium-zirconium hydride fuel and that the gap between the fuel and the cladding could be measured. Additional tests were performed using nonirradiated samples of known hydrogen content and known gaps between fuel and cladding to establish procedures for neutron radiography of fuels and to provide standards for comparison with future tests. Hydrogen differences of 0.02 H/Zr atom ratio can be determined from the radiograph using known standards for comparison and gaps between cladding and fuel can be measured to 0.001 inch accurately. Author (NSA)

N71-24541*# California Univ., Livermore. Lawrence Radiation Lab.
IRRADIATION STUDIES OF URANIUM NITRIDE
E. D. Albrecht, A. J. Rothman, J. D. Lee, J. M. Johnson, and W. N. Hayes, Jr. *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 595–628 refs Sponsored by AEC (See N71-24501 13-22)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18J

A fission heated, gas bonded, binary gas controlled irradiation capsule containing eight uranium nitride specimens was irradiated for eight cycles. The median specimen temperature ranged from 1307 C to 1417 C and the average burnup was 2.3 × 10 to the 20th power fiss/cu cm. Each specimen was composed of from one to three segments and was clad in vented W-25.5 Re having a wall thickness of 0.020 inch. Neutron radiographs were made of the capsule before irradiation and at the conclusion of each cycle, and an extensive postirradiation examination was made. The only significant changes observed in the microstructure were the creation of fine porosity at the grain boundaries of all polycrystalline specimens and the preferential alignment of this porosity in those grain boundaries lying parallel to a specimen surface. Retained fission gas analyses by mass spectrometric techniques showed that nearly 100% of the fission gas generated was retained in each specimen. The fine grain, 96% dense UN swelled the greatest amount at 1417 C and to a lesser extent at 1347 C. The fine grain, 78% dense and single crystal, 100% dense UN showed the least swelling. Author

N71-24542*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIENCE WITH INSTRUMENTED CAPSULES FOR HIGH TEMPERATURE IRRADIATION OF FUEL FORMS
H. J. Reilly *In its* Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 631–636 refs (See N71-24501 13-22)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18J

Experience with a first generation UO2-fuel, tungsten-clad test capsule was used to make substantial improvements in the second generation capsule. Also the experience resulted in two changes in PBRF practices in experiment design: mock-up reactor measurements are required for prediction of flux perturbation factor for fueled experiments and uncertainty analyses are required for all experiments. An experimental program was initiated to give more accurate ways of predicting perturbation factors and a calculational program was initiated to give more information on gamma heating in tungsten. An experimental program to measure relative heating in specimens of varying atomic number and thickness is underway. Author (NSA)

N71-24543*# Battelle Memorial Inst., Columbus, Ohio.
ASSEMBLIES FOR THERMAL AND FAST FLUX IRRADIATION OF (UPu)N FUELS
E. O. Fromm and N. E. Miller *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 637–651 (See N71-24501 13-22)
(Contract W-7405-eng-92)
Avail: NTIS HC$9.00/MF$0.95 CSCL 18J

The irradiation behavior of mixed uranium-plutonium fuels is being investigated as a part of the program on the development of mixed nitride fuelds for high-gain LMFBR's. Both thermal and fast neutron irradiations are being performed; irradiation conditions include fuel burnups to 150,000 MWd/t, cladding temperatures to 700 C and fission heat generation rates in excess of 40 kW/ft. The thermal irradiation capsule experiments are being performed in the MTR and ETR to serve as a basis for planning the fast flux irradiations in EBR 2. Author (NSA)

N71-24545*# General Electric Co., Pleasanton, Calif. Irradiation Processing Operation.

FLOWING SODIUM CAPSULES IN THE GENERAL ELECTRIC TEST REACTOR

G. W. Tunnell and D. L. Brown *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 669–678 refs (See N71-24501 13-22)

Avail: NTIS HC$9.00/MF$0.95 CSCL 18I

The development of a facility to conduct fuel tests in a flowing liquid metal environment in a thermal test reactor is discussed. This facility allows fuel tests to be conducted at coolant velocities, powers, and temperatures which represent operating conditions for LMFBR and space power reactors. The capsule consists of concentric annuli in a closed loop coolant flow path. The flexibility of the design allows particular experiments to meet specifications within wide ranges of power and temperature levels, coolant flow rate, and neutron flux and spectrum. 3 references. Author (NSA)

N71-24546*# General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation.

FAST REACTOR FUEL TESTING IN FORCED CONVECTION CAPSULES

P. E. Novak, H. C. Pfefferlen, R. E. Murata, and G. W. Tunnell *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 679–689 refs (See N71-24501 13-22)

Avail: NTIS HC$9.00/MF$0.95 CSCL 18I

The mechanical and thermal design parameters of the forced convection capsule are presented. Operation of an initial test using a forced convection capsule is described. The capsule permits the use of extensive instrumentation and a range of temperatures and flow-rates. NSA

N71-24547*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESIGN OF A LEAD TYPE CAPSULE SYSTEM TO INVESTIGATE THE RADIOLYSIS OF WATER

Dean W. Sheibley *In its* Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 690–697 refs (See N71-24501 13-22)

Avail: NTIS HC$9.00/MF$0.95 CSCL 18D

The capabilities and design requirements of lead-type capsule systems are discussed. The systems allow in-pile measurements of pressure, temperature, and neutron fluxes during reactor operation. A capsule system has been shown to withstand and contain a 15,000 psi reflected shock wave due to detonation of confined gases. Author (NSA)

N71-24548*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A DOUBLY TELESCOPING DESIGN OF A NUCLEAR REACTOR EXPERIMENT CONTAINING EIGHT VARIABLES

Dean W. Sheibley, Arthur G. Holms, and Steve M. Sidik *In its* Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 698–732 refs (See N71-24501 13-22)

Avail: NTIS HC$9.00/MF$0.95 CSCL 18I

A blocked two-level factorial experiment was designed to measure the pressure buildup due to radiolysis of water. Effects of controlled variables are influenced by changes in radiation environment with time and by equipment changes between groups of reactor cycles; the experiment is therefore doubly confounded. Experimenting is subject to unplanned curtailments with respect to the second. So that the more important parameters can be estimated free of biases ordinarily resulting from the indefinite size of the experiment, the rationale is given for arranging the blocks of the experiment in a doubly telescoping (orthogonally blocked) sequence. Author (NSA)

N71-24549*# United Nuclear Corp., Elmsford, N.Y.

FAST REACTOR SODIUM BONDED FUEL ROD EVALUATION IN A THERMAL REACTOR

Michael H. Montgomery, Carl J. Grando, and Alfred A. Strasser *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 733–741 (See N71-24501 13-22)

Avail: NTIS HC$9.00/MF$0.95 CSCL 18J

The radiation testing of Na-bonded, PuC–UC fuel rods at high burnup is described. An instrumented Na-bonded, PuC–UC fuel capsule has been designed to operate at a minimum linear power of 820 W/cm to an exposure of 35 × 10 to the 20th power fiss/cu cm. Author (NSA)

N71-24550*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A CAPSULE DESIGN FOR DYNAMIC IN-PILE FRICTION EXPERIMENTS

T. P. Jacobson, R. E. Kerkhoff, and H. H. Christenson *In its* Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 743–758 (See N71-24501 13-22)

Avail: NTIS HC$9.00/MF$0.95 CSCL 18I

A capsule design is described for a lubricant irradiation experiment at the NASA Plum Brook Reactor Facility. The capsule contains a friction and wear test apparatus for conducting dynamic experiments in reactor radiation up to 5 × 10 to the 12th power n/sq m/sec (E > 1 MeV). Techniques that increase the reliability of these experiments and improve the hot lab capability of making repairs are illustrated. These techniques include special methods of measuring and controlling test specimen temperature and a modular design using linear variable differential transformers to measure friction coefficients during radiation exposure. Initial in-pile operations are also discussed. Author (NSA)

N71-24551*# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

REMOTE ENCAPSULATION AND TREAT CAPSULE HANDLING TECHNIQUES

G. E. Culley and M. E. McMahan *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 759–774 (See N71-24501 13-22)

Avail: NTIS HC$9.00/MF$0.95 CSCL 18J

Equipment and procedures have been developed for the remote encapsulation of pre-irradiated fuel pins to be transient irradiated in the TREAT facility in support of the FFTF driver fuel development program. The GETR type fuel pins are irradiated in an instrumented NaK-bonded capsule which is remotely encapsulated by inserting the GETR capsule into a pressure vessel known as a TREAT capsule. The EBR-2 type fuel pins are removed from the sodium-bonded capsules used during steady-state irradiation and reencapsulated into an instrumented capsule very similar to the GETR capsule which is, in turn, inserted into the TREAT capsule. The remote equipment utilized during reencapsulation includes a fuel pin profilometer, a gamma scanner, a programmed welding station a leak detection system, and a NaK filing system. The equipment used in encapsulating into the TREAT capsule includes a positioning table, a torque wrench, a leak detection system, and an instrumentation and heater checkout system. Shipping cask handling facilities which enable the use of the T-2 cask horizontally include a motorized dolly and turntable. NSA

N71-24552*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE DESIGN AND IN-PILE OPERATION OF INSTRUMENTED HYDRAULIC CAPSULES

Robert G. Rohal *In its* Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 775–783 (See N71-24501 13-22)

Avail: NTIS HC$9.00/MF$0.95 CSCL 18I

An in-pile hydraulic capsule facility was designed, built, and tested which permits temperature readings within the capsule to be obtained without the use of leads coming directly from the capsule. This is accomplished by using pins which penetrate the capsule walls through an insulating ceramic seal. The portion of the pin inside the capsule is connected to one leg of a thermocouple. The exterior portion has a spring attached which contacts a commutator permanently installed in the in-pile facility. The other leg of the thermocouple is grounded to the facility. The thermocouple signal is transmitted from the capsule through the pin to the commutator by the spring, and from the commutator to recorders by permanent leads. Author (NSA)

N71-24578*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THE POTENTIAL OF NUCLEAR MHD ELECTRIC POWER SYSTEMS

G. R. Seikel and L. D. Nichols 1971 12 p refs Proposed for presentation at AIAA 7th Propulsion Joint Specialist Conf., Salt Lake City, 14–18 Jun. 1971

(NASA-TM-X-67829; E-6304) Avail: NTIS CSCL 18L

The performance of the turbo-MHD cycle is compared with the equivalent Brayton-MHD and Brayton-turboelectric cycles. For the MHD cycles, a top temperature of 2500 K is assumed and two working fluids are considered. For the cycles with turbines, two turbine inlet temperatures are considered: 1500 and 1250K. The cycle temperatures, efficiencies, and specific radiator areas are compared for these various space power systems. The efficiency of the turbo-MHD system is also presented for ground power plants. The specific masses of man shielded 10 MW electric space power systems are estimated. A brief discussion is then presented of the technology of the two most critical components of such an MHD systems. Included in this discussion is a possible modification of the turbo-MHD cycle to minimize the problems associated with alkali-metal-seeded generators and reactor fission product release. Author

N71-24634*# Aerojet-General Corp., Azusa, Calif. Power Systems Dept.

DESIGN AND DEVELOPMENT OF A CANNED-MOTOR PUMP FOR NaK SERVICE

C. P. Colker, C. S. Mah and C. L. Foss Apr. 1971 50 p refs

(Contract NAS5-417)

(NASA-CR-72823; AEROJET-3663) Avail: NTIS CSCL 18N

A pumping system for high temperature (1170 F) service in a nuclear-electrical power conversion system (SNAP-8) for use in space was designed and developed. The service fluid was a eutectic mixture of liquid sodium and potassium (NaK 78). The pumping system consisted of a pump-motor combination operating on NaK-lubricated hydrodynamic bearings, and a cooling-purification system which circulated filtered and cooled NaK lubricant. The lubricant NaK is drawn from the primary pumped fluid. Tests totaling 31,136 hours (as of December 1968), including an endurance run of 10,362 hours with 786 startups, have been conducted. The pumping system has met the design objectives, including the 10,000-hour life requirements. Examination of the detailed parts of the pump motor after the endurance test showed that the only damage on the pump-motor components were minor surface scratches on the running surfaces of the tool steel radial bearings. Author

N71-24635*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

REACTOR IRRADIATION OF THERMIONIC SHEATH INSULATORS

John T. Mayer Washington May 1970 23 p

(NASA-TM-X-2271; E-5955) Avail: NTIS CSCL 18I

Two beryllia and two alumina bonded trilayers (with niobium as the inner and outer layers) were irradiated at an average temperature of about 1200 K. The total fast fluence was between 2.3 × 10 to the 21st power and 2.6 × 10 to the 21st power neutrons/sq cm (energy > 160 fJ (1 MeV)). None of the trilayers showed any gross changes in either the ceramic or in the metal-ceramic bond, although the alumina did show signs of grain boundary weakening. The sample diameters grew by 0.4 to 0.9 percent. Postirradiation ac resistance at 1275 K was higher than pretest values by as much as a factor of five. Author

N71-24688*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FUSION ROCKET CONCEPTS

John J. Reinmann [1971] 14 p refs Presented at the 6th Symp. on Advanced Propulsion Concepts, Niagara Falls, N.Y., 4–6 May 1971

(NASA-TM-X-67826) Avail: NTIS CSCL 21F

Steady-state thermonuclear rocket systems are investigated which are characterized by high specific impulse and relatively low specific mass. The objectives are: (1) to estimate achievable specific masses, (2) to identify the differences between ground power and space propulsion application, (3) to identify critical problem areas, and (4) to suggest priorities for future research needs. Specific masses were estimated to range from 1 to 0.5 kg/kW for rockets in the 200 to 1000 MW jet-power range respectively. Fusion rockets should provide variable specific impulse from 2500 to 200 000 sec for optimum propellant utilization. Efficient extraction of energy from a toroidal reactor in the form of charged particles, and efficient conversion of the charged particle energy into jet power are major challenges in the application of fusion to space propulsion. Author

N71-24689*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESIGN POINT CHARACTERISTICS OF A 15-TO-80 kWe NUCLEAR-REACTOR BRAYTON-CYCLE POWER SYSTEM

Paul T. Kerwin [1971] 9 p refs Proposed for presentation at the 1971 Intersociety Energy Conversion Engineering Conf., Boston, 3–6 Aug. 1971

(NASA-TM-X-67811) Avail: NTIS CSCL 18L

A study of 15-80 kWe nuclear reactor powered Brayton cycle power system is presented. The system has a design turbine inlet temperature of 1150 F based on the use of a zirconium-hydride reactor but is also required to be capable of operation at turbine inlet temperatures up to 1600 F with an advanced reactor. Considerations involved in the selection of cycle parameters, working fluid, pressure level, and turbomachinery rotational speed are discussed. Size and weight estimates, predicted design-point performance, and required radiator area are presented. Author

N71-24690*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PREDICTED PERFORMANCE OF A 15-80 kWe REACTOR BRAYTON POWER SYSTEM OVER A RANGE OF OPERATING CONDITIONS

D. C. Guentert and R. L. Johnsen [1971] 10 p refs To be presented at 1971 Intersoc. Energy Conversion Eng. Conf., Boston, 3–6 Aug. 1971; sponsored by SAE

(NASA-TM-X-67833) Avail: NTIS CSCL 18L

A computer simulation of a 15-80 kWe nuclear reactor Brayton cycle power system designed for a turbine inlet temperature of 1150 F was used to study the steady-state performance of the system at turbine inlet temperatures between 1050 and 1600 F. The low end of the temperature range is of interest in applications using a zirconium hydride reactor heat source, while the 1600 F temperature assumes the use of an advanced reactor. Cycle-parameter effects and predicted system efficiency and required radiator area are presented over a range of compressor inlet temperatures and turbine inlet temperatures. The performance over a range of power levels is also presented. Author

N71-24691*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MOTOR STARTING TECHNIQUES FOR THE 2-TO-15 kW BRAYTON SPACE POWER SYSTEM
L. J. Gilbert, J. S. Curreri, and D. A. Cantoni [1971] 12 p refs Proposed for presentation at the 1971 Intersociety Energy Conversion Engineering Conf., Boston, 3–6 Aug. 1971
(NASA-TM-X-67819) Avail: NTIS CSCL 18L

The 2-15 kilowatt Brayton space power system has been effectively started by motoring the rotating unit. This Brayton power system generates 120/208 volts, 1200 hertz electrical power at a rated speed of 36,000 rpm. The system is designed for a turbine inlet temperature of 1600 F (1145 K) and can be operated with a variety of heat sources such as a nuclear reactor or radioisotope. By applying 20 volts line-to-neutral, 400 hertz electrical power to the alternator terminals at standstill, the rotating unit can be motored to a speed of 12,000 rpm in about 20 seconds. Upon removal of the input electrical power, the system self-accelerates to its rated speed, provided that the turbine inlet temperature is 875 F (741 K) or higher. Author

N71-24850# Reactor Centrum Nederland, Petten.
FAST REACTOR PROGRAMME Quarterly Progress Report
E. K. Hoekstra, comp. Oct. 1970 73 p refs Sponsored in part by US/Euratom
(EURFNR-855; RCN-130; QPR-1) Avail: AEC Depository Libraries

The RCN program on fast reactor physics, fuel performance, radiation damage in canning materials, corrosion behavior in canning materials, aerosol research, and heat transfer and hydraulics is summarized. Author (NSA)

N71-24851# European Atomic Energy Community, Petten (Netherlands). Joint Nuclear Research Centre.
CRUSHING BEHAVIOUR OF PYROCARBON COATED FUEL PARTICLES
A. Drago and W. Huber 1970 22 p ref
(EUR-4501; EUR-FF-4.45) Avail: AEC Depository Libraries

The importance of the optical analysis of the mode of crushing of stressed coated particles, for the characterization of mechanical behavior of the coating, is examined. Experimental results are discussed. Author (NSA)

N71-24853# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.
THEORY FOR A LEAST SQUARES DESCRIPTION OF RADIAL DISTORTIONS IN IRRADIATED FUEL SHEATHS
R. G. Jarvis Oct. 1970 19 p refs
(AECL-3688) Avail: AEC Depository Libraries; Atomic Energy of Can., Ltd., Chalk River: $0.50

The theory for a standard method to describe distortions in irradiated fuel sheaths is developed. The departures from roundness are measured by deviations from least-squares-circles and the radial displacements of the circle centers from the original element axis describe the bowing and twisting. Author (NSA)

N71-24864# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
REACTOR SHIELDING IN THE COMMISSARIAT A L'ENERGIE ATOMIQUE
C. Devillers [1970] 23 p refs Presented at the Meeting of the European-Am. Comm. on Reactor Phys., Richland, Wash., 7–9 Jul. 1970
(DEP/SEPP-894/70; CEA-CONF-1683; CONF-700711-1) Avail: AEC Depository Libraries

The different codes used at the CEA for calculations concerning reactor protection are examined: NIOBE, ZEUS, TRIPOLI, ANISN, SABINE, MERCURE, as well as the PEPIN LE BREF code which is intended for the study of fission products. The results obtained from calculations of the neutron flux in the thermal column of the Harmonie reactor using the NIOBE, ANISN, and POKER codes are compared. The results obtained from a three-dimensional Monte Carlo calculation of neutron streaming towards Phenix heat exchangers are presented. Author (NSA)

N71-24885# Atomics International, Canoga Park, Calif.
LARGE RADIOISOTOPE HEAT SOURCE CAPSULE (LRHSC) Quarterly Progress Report, Jan.–Mar. 1970
8 May 1970 86 p
(Contract AT(29-2)-2338)
(AI-AEC-12956; QPR-11) Avail: NTIS

Activities directed toward the development of technology for an isotope fuel capsule capable of operation in a space environment at a surface temperature of 2000 F or more for five years or more are summarized. The work includes process, fabrication, and test activities. The process and fabrication has included the work required to define an acceptable manufacturing specification for the reference design capsule and to manufacture the test items required for the program. The test program involves various coupons and capsules with evaluation of chemical compatibility, thermal cycling and adherence of coatings, capsule creep, capsule impact, and capsule survival in potential abort environments. The data generated in this program will be used to validate design approaches and define design margins that would exist for high temperature capsules intended for flight systems. NSA

N71-24886# Institute of Nuclear Research, Warsaw (Poland).
VOLTERRA FUNCTIONAL SERIES FOR REACTORS WITH LINEAR FEEDBACK
M. Kielkiewicz 1970 9 p refs
(INR-1206) Avail: AEC Depository Libraries

The Volterra kernels for the general case of a reactor with delayed neutrons and a linear absolutely integrable reactivity feedback were determined. The convergence of the Volterra functional series was investigated. Author (NSA)

N71-24907# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
ECCS VARIABLE FLOODING RATE SIMULATION PWR FLECHT TEST RESULTS
F. F. Cadek, D. P. Dominicis, R. H. Leyse, and J. O. Cermak [1970] 5 p refs
(Contract AT(10-1)-1230)
(WCAP-5352) Avail: NTIS

The results of tests simulating a typical core reflooding rate for a double ended cold leg break are presented. The effects of entrained liquid fallback on clad temperature response are discussed. NSA

N71-24908# Japan Atomic Energy Research Inst., Tokyo.
DETECTION OF FAILED FUEL AT JRR-4
Minoru Morozumi Nov. 1970 31 p refs In JAPANESE
(JAERI-MEMO-4196) Avail: AEC Depository Libraries

The Japan Research Reactor No. 4 (JRR-4) is a swimming pool type reactor using MTR type fuel elements. The reactor has a fuel failure detection (FFD) system consisting of delayed neutron detection. The system does not indicate the failed fuel element. The FFD's indication had gradually increased for the period between July 1968 and March 1969. The following tests were applied: flux tilting method, sipping method for in core fuels, and sipping method for a fuel held in the ruptured fuel test can. The failed fuel element was then identified. Author (NSA)

N71-24909# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Reaktorentwicklung.
SOLUBILITY OF INERT GASES IN THE REACTOR COOLANT SODIUM AND RELATED SAFETY PROBLEMS

K. Thormeier May 1970 117 p refs Transl. into ENGLISH from German report Sponsored in part by AEC-Euratom
(EURFNR-785) Avail: NTIS

The investigation covers a wide range of temperatures and pressures. A theoretical relation for Henry's coefficient can be derived from statistical thermodynamics. This is used for calculation of the solubilities of inert gases in Na on the basis of the model concept that a dissolved gas atom requires a hole of its size in the liquid and that the gas atom, once it is placed in that hole, interacts with the ambient liquid and is made to vibrate. For experimental verification of these results a method was developed for measurement of the solubility of gases in liquids. The measured results are in good agreement with the values derived theoretically. On the basis of the solubility data thus obtained the significance to safety of the cover gas bubbles (argon and helium, respectively) produced in the Na as a result of temperature changes and the capacity for the fission gases krypton and xenon in Na are regarded for the primary circuit of the fast sodium cooled breeder reactor SNR. Author (NSA)

N71-24922# Japan Atomic Energy Research Inst., Tokyo.
JAERI'S CONCEPTUAL DESIGN OF THE JAPAN EXPERIMENTAL FAST REACTOR, PART 2
Dec. 1970 273 p refs
(JAERI-1177-B-Pt-2) Avail: AEC Depository Libraries

The following subjects of the design are described: the general philosophy and specific aspects of the design; the nuclear characteristics including burn-up behavior of the reactor core; the thermal hydraulic characteristics of the core; the mechanical design of the reactor vessel, the shielding plugs, the internal structure of the vessel, and the core structure including fuel assembly; the fuel handling system; the primary and secondary cooling loop system; the fuel monitoring facility which takes the fuel out of the reactor core periodically after a certain burn up for various kinds of inspections; shielding which shields neutrons and gamma rays from the reactor, and gamma rays from the primary sodium loop; the instrumentation and control systems for the reactor operation, and some results of kinetic analysis of the reactor plant; and the description of the reactor containment building, the waste disposal facilities, and other reactor service facilities for the reactor plant. Safety evaluations such as the analyses of transient behavior, maximum credible accidents, and hypothetical accidents are also described. Author (NSA)

N71-24923# Reactor Centrum Nederland, Petten.
NEUTRON METROLOGY IN THE HFR FLUX DENSITY INFORMATION FOR THE 45 MW CORE CONFIGURATION
Willem L. Zijp and Hugo van der Werve Sep. 1970 43 p
(RCN-119) Avail: AEC Depository Libraries

A compilation of thermal and fast flux density values is presented for the 45 MW core configuration with 6 inner experiment positions. Data are given for the fuel region, the experiment positions occupied by S-assemblies, the poolside facility, and the irradiation facilities for smaller capsules. No data are available for the beam tube arrangements. The values presented should be considered as estimates for nominal values, as the actual flux density values are dependent upon the fuel charge and its distribution over the core, the irradiation experiments installed, and the position of the control members. Some results of multigroup neutron spectrum calculations performed with the TEDDI-M code are also presented. Furthermore data on the damage-to-activation ratio for graphite and steel irradiations in experiment positions are given. Author (NSA)

N71-24924# Applicazioni e Ricerche Scientifiche, Milan (Italy).
CONDOR 3: A TWO DIMENSIONAL REACTOR LIFETIME PROGRAM WITH LOCAL AND SPECTRUM DEPENDENT DEPLETION
E. Salina 1970 82 p refs
(EUR-4539) Avail: AEC Depository Libraries

CONDOR 3, as the preceding nuclear codes of the CONDOR series is a few-group bidimensional lifetime program written in FORTRAN 4 for the IBM 360/65. It couples the method of the spatial modal expansion with the 5 point finite difference method. By means of the spatial modal expansion the program determines the eigenvalue of the reactor, which can be in turn the K sub eff (multiplication factor), the (H) (dilution factor of a diluted poison), the Sigma sub p or the boundary of a prefixed control region. By means of the finite difference method, the program improves the calculation of the K sub eff and the group flux spatial distribution. Author (NSA)

N71-24926# Nuclear Energy Information Center, Warsaw (Poland).
FAST BREEDING REACTORS: BIBLIOGRAPHY, 1966–1969
A. Kowalski, comp. 1970 285 p refs
(NEIC-RR-41) Avail: AEC Depository Libraries

The bibliography on Fast Breeding Reactors is the continuation of the compilation under the title Fast Reactors, published by the International Atomic Energy Agency in the Bibliographical Series No. 22 in 1966. This bibliography includes 2976 references registered in the Nuclear Science Abstracts vol. 20–23 in the period from 1966 to 1969. The Subject Index, Reactors Index, Author's Institution Index, Report Index and Patent Index are given. Author (NSA)

N71-24961# Centre d'Etude de l'Energie Nucleaire, Brussels (Belgium).
EXPERIMENTAL AND THEORETICAL PHYSICS WORK ON PLUTONIUM ENRICHED LWR'S LATTICES Final Report
L. Bindler, L. Leenders, and H. Van Den Broeck Jun. 1970 220 p refs
(EURAEC-2145; EUR-4034; BN-7006-3; BLG-440) Avail: NTIS

The activities up to 1968 of the Belgian program for studying technical and economic aspects of recycling plutonium in thermal light water reactors are summarized. The reactor physics theoretical methods and codes development studies are described. Included are: the preparation of the VENUS critical facility and associated installations; the initial code calibration on the basis of previous experimental data; and experimental and theoretical work on the VENUS-program study of 4% UO2 fuel and mixed 3% UO2-1% PuO2 fuel. NSA

N71-24981# United Kingdom Atomic Energy Authority, Harwell (England). Electronics and Applied Physics Div.
A PROPOSED METHOD FOR USING STANDARD BURST CARTRIDGE PRECIPITATOR EQUIPMENT FOR FUEL ACTIVITY RELEASE MONITORING ON A MK. 3 HIGH TEMPERATURE GAS COOLED REACTOR
J. W. Leake Dec. 1970 29 p refs
(AERE-R-6475) Avail: AEC Depository Libraries; HMSO 4s 6d; BIS$1.00

A method of using standard wire precipitation systems is proposed which will enable them to be used for fuel activity release monitoring on the Mk. 3 high temperature gas cooled reactor. The method involves the division of the normal counting period into two parts (not necessarily equal) and the difference count. It is shown that this permits the detection of releases of relatively small quantities of the short lived Kr and Xe fission products in the presence of large activities of the long lived Kr and Xe nuclides. The increased selectivity between short and long lived activity should enable any significant additional release of activity from the fuel to be monitored. This method, with development, has limited potential for use on Mk. 1 and 2 gas cooled reactors. Author (NSA)

N71-24986# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
MATERIALS RESEARCH IN ATOMIC ENERGY OF CANADA LIMITED

Fall 1970 24 p refs
(AECL-3778) Avail: AEC Depository Libraries; Atomic Energy of Can., Ltd., Chalk River: $0.50

Reviews are presented on technologies concerned with corrosion of water reactor in-core and out-of-core materials, corrosion of Zr alloys by organic coolants, liquid metals, H diffusion in corrosion processes, and plasma anodization. NSA

N71-24687# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Atomnoi Energii.
PROCEDURE FOR CALCULATING CERTAIN PARAMETERS OF HEAT-PRODUCING ELEMENTS OF VVER TYPE [METODIKA RASCHETA NEKOTORYKH PARAMETROV TEPLOVYDELYAYUSHCHIKH ELEMENTOV TIPA VVER]
E. V. Vinokhodov 1969 48 p refs In RUSSIAN
(IAE-1942) Avail: AEC Depository Libraries

A technique for calculating the temperature field, the power reserve prior to fusion of the fuel, the radial and diametral clearances, and the pressure of gaseous fission products in the VVER type of fuel elements is presented. The procedure is exemplified with a calculation of the VVER fuel elements at a power of 1375 MW(t). Author (NSA)

N71-25107# Japan Atomic Energy Research Inst., Tokyo.
CHARACTERISTIC MEASUREMENT OF JRR-2
H. Sakurai Jul. 1970 307 p refs In JAPANESE; ENGLISH summary
(JAERI-Memo-4141) Avail: AEC Depository Libraries

JRR-2 is a thermal reactor using the plate-type fuel elements of 90% enriched uranium with heavy water both as moderator and coolant. The maximum thermal output of the reactor is 10 MW. The operating cycle of three weeks includes 300 hour operation, refueling, and exchange of irradiated samples. To improve the operation mode it has become necessary to increase the reactivity in JRR-2 by adding more fissile material. Therefore, the content of U-235 in the fuel was increased by 10%. Characteristics of the new core were measured during the period from December 1969 to February 1970. Main items of the measurements were as follows: critical mass measurements, control rods calibration, neutron and gamma flux measurements, measurements of various reactivity worths, power calibration and xenon buildup measurements. Author (NSA)

N71-25130# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.
MULTICYCLE IRRADIATION OF HOLLOW UO2 PELLETS IN COLLAPSIBLE ZIRCALOY 2 SHEATHING
A. S. Bain and E. Mizzan Nov. 1970 49 p refs
(AECL-3732) Avail: AEC Depository Libraries; Atomic Energy of Can., Ltd., Chalk River: $1.50

Zircaloy sheathed elements containing UO2 pellets with an axial void (4 vol %) were irradiated in a series of tests in the X-2 loop of NRX. The irradiation confirmed that the hollow pellet fuel elements had lower dimetral expansions than solid pellet fuel irradiated at the same power. Circumferential ridges and fission gas release were similar to previous data of other highly rated fuel. The tests also confirmed that instability of the sheathing occurred if the fuel was operated above the melting point. Four defect mechanisms were considered: internal contamination, faulty tubing, stress rupture, and internal attack by fission products. One element almost certainly defected because of a tubing fault, and others probably contained a small amount of an internal hydrogenous contaminant. The most probable cause of the majority of the defects was the inability of the specific batch of tubing to yield during a slight power increase. Author (NSA)

N71-25131# Los Alamos Scientific Lab., N.Mex.
NUCLEAR SAFEGUARDS RESEARCH AND DEVELOPMENT
Program Status Report, May – Aug. 1970
Sep. 1970 34 p refs
(Contract W-7405-eng-36)
(LA-4523) Avail: NTIS

Equipment and methods for the neutron interrogation and nondestructive analysis of fissionable materials are described. Results of tests on one-gallon recovery cans of Pu scrap are given. Information is presented on radioactive neutron sources for nondestructive assay applications; delayed neutron yield versus energy measurements; passive neutron and gamma-ray assay of prototype LMFBR fuels; detector and instrumentation development; computational and data acquisition facilities; and mobile nondestructive assay laboratory. NSA

N71-25179# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
HEAT TRANSFER MEASUREMENTS ON TREFOIL FUEL BUNDLES IN THE POST DRYOUT REGIME WITH DATA TABULATION
D. C. Groeneveld, M. Thibodeau, and G. D. McPherson Aug. 1970 refs
(AECL-3414) Avail: AEC Depository Libraries; Atomic Energy of Can., Ltd., Chalk River: $1.00

Heat transfer tests in the post-dryout regime were done on a string of three fuel bundles irradiated in the NRX reactor. The bundles consisted of a cluster of three elements (15.24 mm OD, 500 mm long) in a 37.44 mm ID test section. Measurements were taken at a pressure of 63 bars, at mass velocities ranging from 110 to 220 g/sq cm s, at heat fluxes of 33 to 116 W/sq cm and at steam qualities of 30 to 60% with both clean and crudded fuel sheath surfaces. Dimensional changes in the fuel during post-dryout operation may explain anomalous temperature patterns. The data are correlated with a revised Miropol'skiy equation. Author (NSA)

N71-25189# Argonne National Lab., Ill.
MELTDOWN ANALYSIS OF VARIOUS EBR-2 CORE CONFIGURATIONS USING THE MELT-2 CODE
G. H. Golden and R. H. Shum Nov. 1970 29 p refs
(Contract W-31-109-eng-38)
(ANL-7752) Avail: NTIS

Effects of unbounded input-reactivity ramps on three types of EBR-2 core configurations were studied with the MELT-2 code. One core contained only metal fuel and was similar to the wet critical configuration; a second was a hypothetical mixed-oxide configuration; and a third contained both fuels in amounts typical of a recent irradiation configuration of the reactor. Feedback reactivity was assumed to be due to axial expansion of fuel, and, after melting, to gravity-induced fuel collapse. Collapse was taken to being at a given point in the reactor when one of four specified input temperatures was exceeded; these temperatures were related to the fuel and cladding melting points or eutectic temperature and the normal boiling point of the coolant. The resulting model for noncoherent collapse resulted in much smaller collapse reactivity rates than those predicted earlier by use of a model for simple, coherent collapse. Author (NSA)

N71-25206# Japan Atomic Energy Research Inst., Tokyo.
IRRADIATION TESTS OF DOMESTIC ZIRCALOY-2 CLADDING MATERIALS IN JPDR
Sueo Nomura, Noboru Ito, and Kenzo Honma Nov. 1970 20 p refs In JAPANESE; ENGLISH summary
(JAERI-Memo-4192) Avail: AEC Depository Libraries

In order to perform surveillance tests of Zircaloy-2 fuel cladding material, three types of Zircaloy-2 sample coupons for corrosion, tensile, and Charpy impact tests were inserted into the three positions of different neutron flux in the JPDR. The coupons were removed after one year, then mechanical tests and corrosion examination were conducted. Corrosion of irradiated samples was accelerated with increase of neutron dose. Results of tensile tests indicated increases of ultimate and yield strengths and a decrease of total elongation with increase of neutron exposure. No clear

conclusion was obtained on the effects of neutron irradiation on impact properties. The results of induced activity measurement and gamma-ray spectrometric analysis of coupons and crud are also presented. Author (NSA)

N71-26207# Argonne National Lab., Ill.
SPECIFICATION AND PROCUREMENT OF CP-5 FUEL TUBES
A. B. Shuck, J. C. Haugen, S. Isserow (Whittaker Corp., West Concord, Mass.), and R. F. Huber (Whittaker Corp., West Concord, Mass.) Aug. 1970 61 p
(Contract W-31-109-eng-38)
(ANL-7708) Avail: NTIS

Fuel assemblies for the Argonne National Laboratory Research Reactor CP-5 consist of concentrically nested, Al-clad, Al-U alloy fuel tubes. The fuel is prepared by dissolving fully enriched U in molten Al and casting hollow cylindrical billets. The billets are extruded as tubes from which cylindrical cores are machined. These are clad inside and outside in sealed Al jackets, which are bonded to the cores by coextrusion. The resulting Al-clad fuel tubes are radiographed, cut to length, blister-tested, cleaned, inspected, and sent to Argonne National Laboratory for construction of CP-5 fuel assemblies. Data from manufacture and inspection of 37 sets of the fuel tubes were evaluated, and a detailed procurement specification was prepared for future procurement of the tubular elements. Author (NSA)

N71-26208# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
CRITICAL EXPERIMENTS IN AN MTR MOCKUP USING PHOENIX FUEL
E. C. Davis, Jr., R. I. Smith, and L. D. Williams Jun. 1970 90 p refs
(Contract AT(45-1)-1830)
(BNWL-1481) Avail: NTIS

Utilization of Pu-240 as a convertible poison in plutonium-fueled systems is being studied under the Phoenix fuel reactor program at Pacific Northwest Laboratory. An extensive experimental program using Phoenix fuel in a critical mockup of the Materials Testing Reactor (MTR) was completed in the Plutonium Recycle Critical Facility. The PRCF-Phoenix mock-up duplicated as closely as possible the physical configuration the MTR in order to determine the characteristics of such a core. The experiments performed in this mock-up provided information on the reactivity effects and power distributions to be expected of an MTR-Phoenix fuel core prior to the loading of a full core in the MTR. These data have provided an excellent test of the computational methods currently being applied to Phoenix fuel cores. The results of the PRCF experiments are presented. Author (NSA)

N71-26216# Idaho Nuclear Corp., Idaho Falls.
ELECTROLYTIC BEHAVIOR OF NUCLEAR FUEL CLADDING ALLOYS
L. C. Lewis and B. C. Musgrave Jan. 1971 38 p refs
(Contract AT(10-1)-1230)
(IN-1295) Avail: NTIS

The electrochemical properties of aluminum, nickel-based, and stainless steel cladding alloys for nuclear fuels were examined using a galvanostat. The alloys were types 304, 304L, 347, 309, and 316 stainless steel, Nichrome, and types 1100, 2219, 6061, and X8001 aluminum. Special experimental aluminum-silicon alloys were also tested. In addition, a sample of type 304 stainless steel irradiated in EBR-II was examined. Surface effects which were related to the conditions of irradiation, and which did not exist with unirradiated material, were discovered with the irradiated type 304 stainless steel. It was demonstrated that the galvanostat could be used for an investigation of catalyst activity, for identification of alloys, and for the study of surface effects. Electrolytic dissolution was proven to be possible for all alloys examined. Author (NSA)

N71-26217# WADCO Corp., Richland, Wash.
COMPARISON OF TWO DIMENSIONAL AND THREE DIMENSIONAL NEUTRONICS CALCULATIONS FOR THE FTR
R. W. Hardie and W. W. Little 9 Sep. 1970 5 p refs Presented at the 17th meeting of the Am. Nucl. Soc., Washington, D.C., Nov. 1970
(Contract AT(45-1)-2170)
(WHAN-SA-11; CONF-701102-10) Avail: NTIS

Although most survey fast reactor physics calculations are performed using either one- or two-dimensional models, certain detailed design computations may require a three-dimensional model. To assess differences between two-dimensional and three-dimensional diffusion calculations, 2DB and 3DB runs simulating the FTR were performed. The items investigated include burnup, fuel worth, poison rod worth, and power peaking. Author (NSA)

N71-26218# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
MOLYBDENUM DISTRIBUTION IN IRRADIATED OXIDE FUELS
L. A. Lawrence and J. A. Christensen 3 Nov. 1970 14 p refs Presented at meeting of the Am. Nucl. Soc., Washington, D.C., 15-19 Nov. 1970 Prepared in cooperation with WADCO Corp.
(Contracts AT(45-1)-1830; AT(45-1)-2170)
(WHAN-SA-96; CONF-701102-13) Avail: NTIS

Electrons microprobe analyses of metallic fission product inclusions in mixed-oxide fuels for molybdenum were performed. A decrease in the molybdenum concentration of metallic fission product inclusions moving toward the fuel center was measured. Because of the relatively short half-life of the only gamma active molybdenum isotope present gamma ray microbeam scanning and similar experimental techniques were not previously possible. Because of the close proximity of the special irradiation facilities at the Hanford reactors to the Radiometallurgy laboratory, it was possible to reduce the elapsed time from sample discharge to postirradiation examination to less than one week. This short elapsed time permitted gamma-ray spectrometric techniques to be used for measuring molybdenum activity profiles in several irradiated UO2-25 wt % PuO2 fuel pins. Author (NSA)

N71-26220# WADCO Corp., Richland, Wash.
CERAMIC FUELS
E. A. Evans and W. F. Sheely Oct. 1970 36 p refs Presented at the meeting on Educ. and Res. in the Nucl. Fuel Cycle, Norman, Okla., 6 Oct. 1970
(Contract AT(45-1)-2170)
(WHAN-SA-70; CONF-701035-1) Avail: NTIS

The advances in the technology of production and testing of oxide fuels are reviewed. Some of the problems in the development of plutonium-enriched ceramic fuels are discussed, and the programs and test facilities involved in plutonium fuel technology are described. NSA

N71-26221# WADCO Corp., Richland, Wash.
COMPARISON OF CALCULATED AND EXPERIMENTAL WORTHS OF LARGE SAMPLES IN ASSEMBLIES FTR-1 AND FTR-2
R. P. Omberg, R. A. Bennett, and J. V. Nelson 9 Sep. 1970 6 p refs Presented at meeting of the Am. Nucl. Soc., Washington, D.C.
(Contract AT(45-1)-2170)
(WHAN-SA-12; CONF-701102-15) Avail: NTIS

The suggestion that sample size may be responsible for the discrepancy between calculated and measured worths in fast assemblies was studied. Whether this is true can be determined from a set of experiments performed in Critical Assemblies FTR-1 and FTR-2 in which the reactivity worths of large samples of fuel and B4C control material were measured. The assemblies were

constructed in the Zero Power Plutonium Reactor. A comparison between calculation and experiment for all the large sample measurements in Assemblies FTR-1 and FTR-2 is presented. Author (NSA)

N71-25233# Commissariat a l'Energie Atomic Saclay (France). Centre d'Etudes Nucleaires.

IN PILE LOOP BANJO [LA BOUELE BANJO]

J. Lalere and J. Rousseau 30 Sep. 1970 22 p In FRENCH Presented at Euratom Working Group on Irradiation Devices Karlsruhe, West Germany, 8-9 Oct. 1970

(CEA-CONF-1673; CONF-701029) Avail: AEC Depository Libraries

The Banjo loop is described; it consists of a liquid sodium loop and was designed for irradiation in OSIRIS of fuel pins intended to be used in fast neutron reactors. The loop will be placed in the pool around the reactor core in a zone where the thermal neutron flux is high 3.10 to the 14th power and where the heating is small (about 2W/gram). The loop allows several successive irradiations of pins which have or have not already been irradiated. Pins whose external diameters lie between 5 and 10 mm may be accepted without modifying the circuit. The fissile height may reach 600 mm. A total power of 70 Kw can be obtained. Three entirely independent controls allow the sodium input and output temperatures to be set at desired values. NSA

N71-25245# Gulf General Atomic, San Diego, Calif.

SUMMARY OF CORE SUPPORT GRAPHITE AND CARBON RESEARCH AND DEVELOPMENT TEST PROGRAMS FOR THE FORT SAINT VRAIN REACTOR PLANT

R. K. Luci 15 Jun. 1970 113 p refs

(Contract AT(04-3)-633)

(GA-9641) Avail: NTIS

To evaluate the reliability of the components and materials, a test program was conducted. It was found that the selected core support graphite and carbon components as designed are satisfactory and will withstand all anticipated loading conditions. No cracks developed in either the spherical ends of the graphite posts or seats after cycling such an assembly at the design load for the design life of the components. The friction and wear characteristics of the selected graphite and carbon materials are not expected to adversely affect the performance of the core support components. The physical and mechanical properties of the selected graphite and carbon materials meet the minimum specified requirements. Negligible wear and no dimensional changes occurred on a full scale graphite block and post assembly as a result of the simulated thermal cycling test, which was performed at operational load conditions in a helium environment. Clearances and tolerances of the core-support blocks as designed are satisfactory to permit displacements and rotational movements due to differential thermal expansion and seismic conditions. NSA

N71-25247# Fiat S. P. A., Turin (Italy).

NUCLEAR FUEL WITH BURNABLE POISON. PART 1: Gd2O3 MICROSPHERES PREPARATION FROM THE SOL-GEL METHOD Topical Report, 1 Jan. 1968-31 Dec. 1969

G. Abate-Dage, I. Amato, and G. Grappiolo Nov. 1970 44 p refs

(EUR-4550) Avail: AEC Depository Libraries

Gd2O3 microspheres were prepared through the sol-gel method. The process involves the following steps which were optimized for the requested applications: sol preparation, gelation and spherodization, and thermal treatment (presintering and sintering). The sol was prepared by peptization at 80 C for 30 minutes of freshly precipitated gadolinum hydroxide with nitrate ions as stabilizing electrolyte. The concentration of sol was about 2M and the NO3(-)/Gd molar ratio in the range 0.12 to 0.27. The gelation and spheroidization were carried out in a tapered column through dehydration and gelation by an aliphatic long chain alcohol. The gelled microspheres were presintered under vacuum up to 950 C for a total time of about 10 hours in order to decompose the gadolinium hydroxide, nitrate, carbonate, and the absorbed organic substances. The presintered microspheres were hydrogen sintered for 2 to 3 hours at 1600 to 1700 C; microspheres with sintered density very near to the theoretical value were obtained. Author (NSA)

N71-25312*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE EVALUATION OF A PLANAR RADIOISOTOPE THERMOELECTRIC GENERATOR THERMAL MODEL

Joseph F. Fry *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 241-243 (See N71-25256 13-34)

Avail: NTIS CSCL 18N

The performance of a planar radioisotope thermoelectric generator model as a power source was evaluated. The model utilizes a spherical fuel capsule configuration and a radiator fabricated from a large block of hot-pressed beryllium, and its thermophile consists of 12 silicon-germanium thermoelectric couples and 100 thermal analog couples arranged about the center of the radiator. Thermal model results met predicted design goals of 9.5-W power output and performed satisfactorily for 302 hours. Temperature profiles across the radiator and across the multifoil insulation were within 7% of the predicted design values. G.G.

N71-25378# WADCO Corp., Richland, Wash.

LEAKAGE FROM A CONTAINMENT VESSEL

Howard E. Hanthorn 11 Nov. 1970 15 p refs Presented at the 11th AEC Air Cleaning Conf., Richland, Wash.

(Contract AT(45-1)-2170)

(WHAN-SA-40; CONF-700816-6) Avail: NTIS

An attempt was made to obtain a unified expression for leakage flow from a nuclear reactor containment vessel. Such an expression would be useful particularly in investigations of the consequences of postulated reactor accidents occurring within containment vessels. It was found that the curves for leakage rate vs containment vessel overpressure for the three flow regimes (viscous, turbulent, and orifice) were of the same general form and could be fitted with ample accuracy by empirical mathematical formulas of the same type, though the range of flow rate covered was six orders of magnitude. A single empirical formula was obtained covering all three flow regimes with sufficient accuracy for source term calculations without regard to the actual flow regime, between 0.3 and 5 atm overpressure. Author (NSA)

N71-25379# WADCO Corp., Richland, Wash.

ENERGY TRANSPORT IN OXIDE FUEL MATERIALS

J. A. Christensen 9 Nov. 1970 6 p Presented at the US-UK Exchange Discussion on Plutonium, Chicago, 19-20 Oct. 1970

(Contract AT(45-1)-2170)

(WHAN-SA-80; CONF-701033-1) Avail: NTIS

The laser flash diffusivity technique used to measure the thermal conductivity of PuO2-UO2 is described. Measured values for different compositions and temperatures are analyzed. NSA

N71-25380# WADCO Corp., Richland, Wash.

LARGE SCALE AIR CLEANING TEST IN THE CONTAINMENT SYSTEMS EXPERIMENT

R. K. Hilliard and J. D. McCormack 11 Nov. 1970 24 p refs Presented at the 11th AEC Air Cleaning Conf., Richland, Wash. Prepared in cooperation with Battelle-Northwest

(Contracts AT(45-1)-1830; AT(45-1)-2170)

(WHAN-SA-39; Conf-700816-7) Avail: NTIS

Results of five CSE experiments in which an internal recirculating air cleaning loop was run in steam-air atmospheres are

presented. The loop was composed of a commercial sized heat exchanger, demister, filters, and charcoal beds. Variables investigated were loop flow, atmospheric temperature, component arrangement, and aerosol source term. The observed removal of iodine, cesium, uranium, and methyl iodide from the typical water cooled reactor post-accident atmospheres is compared to a mathematic model. Author (NSA)

N71-25406# WADCO Corp., Richland, Wash. Physical Measurement Technology Section.
IN-VESSEL DETECTOR CABLES: SIGNALS OR NOISE?
N. S. Porter, N. C. Hoitink, and C. N. Jackson, Jr. 16 Sep. 1970 18 p Presented at Conf. of Power Reactor Systems and Components, Williamsburg, Va.
(Contract AT(45-1)-2170)
(WHAN-SA-18; CONF-700904-4) Avail: NTIS

Several coaxial cables are investigated under the conditions of reactor cores: high gamma fluxes and temperatures near 1200 F. The exact mechanisms of cable failure by breakdown pulse remain unknown, but it is concluded that the type of dielectric is definitely a factor. NSA

N71-25411*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY IMPACT SPEED AND ANGLE CRITERIA FOR DESIGN OF A NUCLEAR AIRPLANE FISSION PRODUCT CONTAINMENT VESSEL
Patrick M. Finnegan, Richard L. Puthoff, and James W. Turnbow (Dyn. Sci. Corp., Phoenix, Ariz.) Washington May 1971 37 p
(NASA-TM-X-2245; E-6025) Avail: NTIS CSCL 21F

Reports and photographs of 96 major accidents occurring before 1965 and involving multiengine jet aircraft were studied. Impact speed and angle are presented for landing and takeoff accidents, cruise accidents without in-flight structural failure, and in-flight structural failure accidents. The landing and takeoff accidents had an average impact velocity of 200 ft/sec from any direction and a maximum impact velocity of 300 ft/sec with a 10 deg solid angle about the roll axis. The cruise accident without structural failure had an average impact velocity of 400 ft/sec and a maximum possibly as high as 1000 ft/sec (305 m/sec), both within a 10 deg solid angle about the roll axis. The in-flight structural failure accident had an average impact velocity of 400 ft/sec (122 m/sec) from any direction and a maximum possibly as high as 1000 ft/sec (305 m/sec) within a 10 deg solid angle about the roll axis. The in-flight structural failure accident determines the most severe impact speed for all impact angles. Author

N71-25422# Reactor Centrum Nederland, Petten.
POST-FAILURE EXAMINATION OF THE IN-PILE SECTION OF THE PRESSURIZED WATER LOOP IN THE HFR AT PETTEN
A. van der Linde Aug. 1970 67 p
(RCN-125) Avail: AEC Depository Libraries

After 637 days in-core service the stainless steel in-pile section of a pressurized water loop failed. The loop was mounted in the H-5 and H-6 positions of the HFR. Post failure examination of in-pile components in situ and after dismantling in the hot laboratory revealed that failure was most likely caused by HFR water leakage, through a leak in and insulation pipe, into the space between the pressure tubes and their mantle pipes. This leaking insulating pipe, fabricated from AISI-347 material, was located 60 cm above the top of the core at a position where the inlet and outlet branches are connected with the vertical U-shaped section. Measurement of the room temperature tensile properties of specimens made out of the pressure tubes showed that alternate irradiation results in a smaller increase in yield strength and decrease in total elongation than that encountered for comparable stainless steel which was irradiated continuously at 290 C up to the same fluence level. Author (NSA)

N71-25441# Battelle Memorial Inst., Columbus, Ohio.
EVALUATION OF THE APPLICABILITY OF EXISTING DATA TO THE ANALYTICAL DESCRIPTION OF A NUCLEAR REACTOR ACCIDENT Quarterly Progress Report, Oct.–Dec. 1970
Wayne A. Carbiener and Robert L. Ritzman Jan. 1971 32 p refs
(Contract W-7405-eng-92)
(BMI-1897) Avail: NTIS

To obtain maximum use of the data being developed in a number of widely scattered and diverse programs, programs from other technologies, it is necessary to evaluate them in terms of their applicability to the ultimate prediction of the space-time distribution of radioactive material following a nuclear-reactor accident. Such an evaluation will serve three purposes, each important to the safe and orderly development of the nuclear-power industry: expose inadequacies of existing data and consequently show where data are needed; refine the techniques of mathematical analysis as applied to this problem; and provide more accurate descriptions of the course and consequences of nuclear accidents, allowing more efficient use of precautionary measures. To accomplish the task, it is necessary to combine methods of analytical description with the scientific and engineering data available. This study is restricted to pressurized-water and boiling-water nuclear steam supply systems, in which the limiting postulated accident considered for safety analyses is the loss-of-coolant or blowdown situation. Author (NSA)

N71-25478# General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation.
SODIUM-COOLED REACTORS FAST CERAMIC REACTOR DEVELOPMENT PROGRAM Quarterly Report, Aug.–Dec. 1970
Dec. 1970 165 p refs
(Contract AT(04-3)-189)
(GEAP-10028-36) Avail: NTIS

Reactor program development data are presented for the following tasks: defective fuel behavior; transient overpower and loss of flow, safety experimentation; fuel materials properties and performance, fast flux testing; core design analysis; kinetic analysis; cladding; core physics; and fuel element design analysis. E.C.

N71-25479# Kernforschungszentrum, Karlsruhe (West Germany).
CAN FAILURE STEAM LOOP [DER HUELLENSCHADEN-DAMPFKREISLAUF (HSD-LOOP)]
S. Jacobi, I. Rautenberg, H. Beitner, W. Golly, U. Kujath et al Aug. 1970 92 p refs In GERMAN; ENGLISH summary
(KFK-1255) Avail: NTIS

The release of fission products and fuel particles from a failed reactor fuel element, their transport and detection in steam, their deposition and decontamination of circuit components, the corrosion resistance of reactor materials, and the behavior of failed fuel elements as important design parameters of steam cooled reactors were studied. For experiments of this kind a superheated steam test loop has been installed at the FR 2 reactor at Karlsruhe. This loop consists of a steam generator unit, an in-pile test bed for accommodation of the fuel pins, and an expansion unit, condenser and low pressure section. The loop is controlled automatically and is run with indirect supervision. A two-out-of-three selection circuit actuates shutdown of the FR 2 reactor as soon as unsafe operating conditions are approached. Author (NSA)

N71-25516# Gulf General Atomic, San Diego, Calif.
GAS-COOLED FAST BREEDER REACTOR Quarterly Progress Report, 1 Nov. 1969–31 Jan. 1970
27 Feb. 1970 50 p refs
(Contract AT(04-3)-167)
(GA-9838) Avail: NTIS

The activities during this period are reported. Topics discussed include: effects of fast neutrons on microstructure of stainless steels, radiation effects on gas cooled fast breeder reactor fuel elements of plutonium oxides, and core development for fast breeder reactors. F.O.S.

N71-25521# WADCO Corp., Richland, Wash.
EFFECT OF FABRICATION VARIABLES ON THE DISSOLUBILITY OF UNIRRADIATED MECHANICALLY BLENDED MIXED OXIDE FAST REACTOR FUEL
R. E. Lerch and D. F. Schiefelbein (Battelle-Northwest, Richland, Wash.) Dec. 1970 64 p refs
(Contract AT(45-1)-2170)
(WHAN-FR-34) Avail: NTIS

A statistical, fractional factorial experiment was performed to determined the effect of six fuel fabrication variables on the dissolubility of unirradiated, mechanically blended PuO2 – UO2 fuels. The six fabrication variables were source of PuO2, PuO2 content, sintering temperature, sintering time, rate of temperature rise during sintering, and pellet pressing pressure. All six fabrication variables had some effect on pellet dissolubility with source of PuO2, PuO2 content, and sintering temperature having major effects. Author (NSA)

N71-25522# Sandia Corp., Albuquerque, N.Mex.
TASK 8 FUEL CAPSULE IMPACT TEST (TRANSIT REFERENCE DESIGN)
L. L. Keller, Jr. and D. E. Randall Nov. 1970 78 p refs Sponsored by AEC
(SC-DR-70-127) Avail: NTIS

Five Task 8 fuel capsule assemblies fabricated on the basis of preliminary Transit drawings (design status as of approximately October 1969) were impact tested to investigate their response to simulated earth impact following reentry from orbit. Two capsule assemblies were bare, and three were enclosed in graphite heat shields. The assemblies experienced considerable distortion, and in three instances the clad was breached. There was no detectable radioactive contamination on the capsule surfaces following the impact tests. Author (NSA)

N71-25524*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AIRBREATHING NUCLEAR PROPULSION, A NEW LOOK
Frank E. Rom [1971] 23 p refs Presented at 6th Symp. on Advanced Propulsion Concepts, Niagara, N.Y., 4–5 May 1971; sponsored by AFOSR
(NASA-TM-X-67837) Avail: NTIS CSCL 21F

Aircraft that could fly anywhere on the surface of the earth or remain aloft for weeks at a time without refueling is discussed. Such an aircraft or air cushion vehicle would be nuclear propelled with complete radiation shielding for crew and passenger safety, and have safety provisions designed to prevent the release of radioactive material in the event of serious aircraft accidents. Other safety features include reactors for long operation without refueling, long life high temperature oxidation resistant heat exchangers, and light weight long life valves and pumps. The economics and practicality of such vehicles are also discussed. E.H.W.

N71-25557# General Electric Co., Pleasanton, Calif. Nuclear Thermionic Power Operation.
TECHNICAL INFORMATION IN SUPPORT OF THERMIONIC REACTOR EXPERIMENT FACILITY COST ESTIMATE
Feb. 1970 416 p refs
(Contract AT(04-3)-771)
(GESR-2123) Avail: NTIS HC $6.00 MF $0.95

The technical description and accompanying backup data used to generate the thermionic reactor experiment (TREX) cost estimate are presented. Guidelines for the facility include: reactor power level at least 100 kW(e); U-235 fueled thermionic fuel elements; a fast neutron spectrum; and a reflector which mocks up a 4 pi shieldable flight reference design. The concept is described beginning with the fuel element and including the core structure, reactor vessel and dome, reflector cup and lift, and reactor design. The TREX control philosophy, power conditioning equipment, and instrumentation and control are discussed. Sections are included describing coolants, the overall facility and proposed modifications, safeguards, and schedule. NSA

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N71-24384# Ballistic Research Labs., Aberdeen Proving Ground, Md.
CIRCUIT ANALOGY FOR SKIN EFFECT IN CONDUCTORS
George D. Kahl and F. N. Weber, Jr. Jan. 1971 17 p refs
(AD-719234; BRL-MR-2087) Avail: NTIS CSCL 20/3

The skin effect in a conductor follows formally from a solution of Maxwells equations. Visualizing the phenomenon from simple physical arguments is difficult and often misleading. This paper presents a parallel circuit analogy for skin effect which exhibits its essential characteristics as well as the inverse skin effects. Author (GRA)

N71-24408# Royal Aircraft Establishment, Farnborough (England).
THEORETICAL ASPECTS OF THE DETERMINATION OF PARTICLE-SIZE DISTRIBUTIONS FROM MEASUREMENTS OF SCATTERED LIGHT INTENSITY
J. B. Abbiss Aug. 1970 46 p refs
(RAE-TR-70151) Copyright. Avail: NTIS

The technique of determining the distribution of particle sizes in a cloud by measuring the intensity of the light scattered from it over a range of angles (sometimes known as the small angles method) is discussed and the feasibility of the method demonstrated with the aid of digital computer calculations. The effect of experimental errors is considered and a detailed examination made of the special difficulties associated with monodispersions, in which all particles are of the same size. It is shown that in both cases modification of the experimental data by means of suitable weighting functions yields enhanced reconstruction of the original distribution function. The limitations of the small angles method are discussed, together with the data requirements which should be met if good results are to be achieved. Author (ESRO)

N71-24496# National Physical Lab., Teddington (England). Div. of Quantum Metrology.
TABLES OF SPECTRAL POWER DISTRIBUTION
O. C. Jones Nov. 1970 54 p refs
(NPL-QU-14) Copyright. Avail: NTIS

A tungsten lamp of known color temperature and intensity may conveniently be used as a standard of spectral power distribution. These tables, which are based on De Vos' values for the emissivity of tungsten, list the absolute spectral radiant intensity per candela, Q(lambda), for both tungsten and blackbody sources for a 10 nm wavelength interval. The temperature range covered is from 1700 to 3300 K in 100 K steps, together with two selected values. To facilitate interpolation the ratio Q(tungsten)/Q(blackbody) is also listed, for use in conjunction with tables of Planck's function. Q(lambda) is given at 10 nm intervals over the range from 240 to 830

nm and at wider intervals to 2600 nm. The accuracy attainable by this method is about + or −1% at the center of the visible spectrum. Author (ESRO)

N71-24637# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
INVESTIGATION OF MANMADE AND NATURAL PERTURBATIONS OF THE EARTH'S ELECTRIC FIELD
C. H. Bonham, III and J. B. Langley 30 Oct. 1970 53 p refs
(Contract Nonr-991(08))
(AD-719428; GIT-A-519-6) Avail: NTIS CSCL 4/1

The report describes an investigation of the effect of low frequency periodic perturbations of the height of a conducting surface on the earths local electric field. Simulation of small, low audio frequency vibrations of a portion of a conducting surface indicate that such displacement will result in perturbations to the normal component of the electric field above that surface. The exact magnitude of these perturbations is a function of the type of probe used to sense the perturbations and the probe-to-surface distance and is, in general, on the order of microvolts. Atmospheric noise spectra were obtained by use of a passive antenna measurement scheme. The data obtained were analyzed using the Fast Fourier Transform and noise spectra on the band 0.1 to 100 Hertz were acquired. The noise spectra thus obtained indicate that atmospheric noise appears to fall off at the rate of 27 dB per decade in the region 0.1 to 100 Hertz. Author (GRA)

N71-24649# Naval Ship Systems Command, Washington, D.C.
PROPAGATION OF SHORT LIGHT PULSES IN A WATER MEDIUM [RASPROSTRANENIYE KOROTKIKH SVETOVYKH IMPULSOV V VODNOY SREDE]
I. P. Ivanov et al Jul. 1970 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Fiz. Atmosfery i Okeana, (USSR), v. 5, no. 2, 1969 p 212–215
(AD-719418; NAVSHIPS-Trans-1243) Avail: NTIS CSCL 20/6

A light signal propagating in a turbid medium disperses in heterogeneities. As a result of this, the various rays follow various paths in space and do not arrive simultaneously at the receiver; this condition leads to a distortion in the shape of the signal which is being received. At this time, one can observe on the screen of the oscillograph, or of any other recording device, the time-dependent scanning of the dispersed signal. Such a scanning contains information concerning the properties of various sectors in the medium. In this manner, a study of the nonstationary scattering opens new possibilities in the investigation of heterogeneous media. This report discusses the effect of the experiments geometry (in particular the values of the base between the transmitter and receiver of their mutual angular orientation and the aperture angular of the receiver upon the temporal prolongation of the light (luminous) signals). The studies were conducted in one of the lakes in Byelorussia. Author (GRA)

N71-24725* Lockheed Missiles and Space Co., Sunnyvale, Calif.
DUAL SOLID CRYOGENS FOR SPACECRAFT REFRIGERATION Patent
Robert P. Caren and Robert M. Coston, inventors (to NASA) Issued 8 Dec. 1970 (Filed 17 Jan. 1969) 8 p Cl. 62-384; Int. Cl. F25b19/00; Int. Cl. F25d3/12 Sponsored by NASA
(NASA-Case-GSC-10188-1; US-Patent-3,545,226; US-Patent-Appl-SN-791888) Avail: US Patent Office CSCL 20L

The argon refrigeration system consists of a container filled with a solid argon cryogen and a heat exchanger which thermally couples the cryogen container to an infrared detector which is maintained at a stable temperature of 50 Kelvin by the refrigeration system. Strict control over the venting rate of the cryogen as it sublimes to the surrounding space environment insures low temperature cooling for an extended time period. Additionally, to insure long duration cooling, all extraneous heat leaks are significantly reduced by thermally isolating the solid cryogen from its warm surroundings. More specifically, a second cryogen container, filled with solid carbon dioxide is provided in stacked relationship to the argon container and a multilayer insulation surrounds the stacked containers to provide a common surrounding vacuum environment. Official Gazette of the U.S. Patent Office

N71-24746# Civil Aeromedical Inst., Oklahoma City, Okla.
NOISE AUDIOMETRY
Jerry V. Tobias Jan. 1971 9 p refs
(FAA-AM-71-1) Avail: NTIS

The displacement of a threshold from its measured-in-the-quiet value to the value it takes in the presence of another sound is masking. Measurement of that displacement is masking audiometry. And the measurement of displacements at a large number of frequencies produces masking patterns. This paper concerns itself with a procedure that produces masking patterns with good precision, sensitivity, and rapidity without the problems of tonal interference and beats that normally interfere with the determination of masking patterns. Several applications of the technique are suggested, including one for determining the auditory effects produced by aircraft noises, and one for testing hearing protectors. Author

N71-24839# Army Electronics Command, Fort Monmouth, N.J. Electronic Parts and Materials Div.
EFFECTS OF ZINC ON THE SWITCHING PROPERTIES OF LITHIUM FERRITE
Richard W. Babbitt Nov. 1970 22 p refs
(AD-719174; ECOM-3362) Avail: NTIS CSCL 9/1

The paper discusses the effects of Zn substitution on the switching and hysteresis loop properties of lithium ferrite cores. The Zn reduced the coercive force and thus permitted the use of smaller grains and hence faster switching time (T sub s). The compositions investigated were: Li(0.5-x/2)Zn(x)Fe(2.5-x/2)04 with x = 0.1, 0.2, and 0.3. Samples were evaluated for grain sizes ranging from 1 to 6 microns. As the grain size was decreased, t sub s decreased and the required drive field (H sub m) increased. Over a substantial range of grain sizes, the decrease in t sub s was faster than the increase in (H sub m). Also discussed are the effects of Zn substitution on the hysteresis loop squareness and temperature stability. Author (GRA)

N71-24857* Kollsman Instrument Corp., Elmhurst, N.Y.
WIDE ANGLE LONG EYE RELIEF EYEPIECE Patent
Seymour Rosin, Rubin Gelles, and Judah Eichenthal, inventors (to NASA) Issued 14 Oct. 1969 (Filed 4 Mar. 1966) 4 p Cl. G02b3/04, 13/18 Sponsored by NASA
(NASA-Case-XMS-06056-1; US-Patent-3,472,577; US-Patent-Appl-SN-532006) Avail: US Patent Office CSCL 20F

A wide angle, long eye-relief eyepiece is described having power, astigmatism, and coma corrections incorporated into a single element which is solely responsible for monochromatic performance and a zero power triplet correcting for lateral color abberation. The single element may be either plano-convex or double convex. Also, a negative field lens properly aspherized to eliminate spherical abberation may be included. Official Gazette of the U.S. Patent Office

N71-24868* National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
OPTICAL MIRROR APPARATUS Patent
Hubert F. A. Tschunko, inventor (to NASA) Issued 17 Nov. 1970 (Filed 11 Mar. 1968) 6 p Cl. 350-310; Int. Cl. G02b5/08
(NASA-Case-ERC-10001; US-Patent-3,540,802; US-Patent-Appl-SN-712099) Avail: US Patent Office CSCL 20F

An optical mirror for reflecting light and including an integral support cage formed by a plurality of cylindrical supports which contact the rear surface of the mirror along continuous paths

concentric with the mirror's optical axis is described. The support cage provides physical stability and minimizes harmful image distortion by producing a surface deformation pattern which qualitatively matches an expected light diffraction pattern of the created images. Official Gazette of the U.S. Patent Office

N71-24887*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FOURIER TRANSFORMABLE PROPERTIES OF PARABOLOIDAL MIRROR SEGMENTS
Akram S. Husain-Abidi and Thomas F. Krile Mar. 1971 20 p refs Submitted for publication
(NASA-TM-X-65520; X-711-71-156) Avail: NTIS CSCL 20F

Theoretical and experimental results are presented to demonstrate advantages of paraboloidal mirror segments over lenses as Fourier transforming and image reconstructing elements in an optical data processing system. Experimental results of spatial filtering are also presented. Author

N71-24905# Cambridge Electron Accelerator, Mass.
SIMPLIFIED RADIAL SURVEY OF THE CEA MAGNET RING
K. W. Robinson and W. A. Schurcliff 10 Aug. 1970 31 p
(Contract AT(30-1)-2076)
(CEAL-1052) Avail: NTIS

The radial-survey method entails use of two of the 48 magnets at a time, rather than four as in the earlier surveys. The line of sight is along the upper radially inner portions of the magnets and thus avoids interferences (by external beam-runs and the bypass) that since 1966 have made the earlier method useless. The longest line of sight is 26 ft, compared to 47 ft in the earlier surveys. The telescope and holder system is mounted on the given magnet in prelevelled and presimed manner, and the same applies to the optical target and holder system. The systems are held in place by gravity; no clamps are used. No fixture plates are required and no leveling or aiming operations. The surveyor's rms error in making telescope readings of relative radial position is 0.001 inch. Author (NSA)

N71-24906 Fordham Univ., New York.
A STUDY OF THE INTERACTION OF LIGHT WITH HYPERSONIC WAVES IN LITHIUM NIOBATE
Ronald James O'Brien (Ph.D. Thesis) 1969 142 p
Avail: Univ. Microfilms Order No. 70-11447

Using a He-Ne laser, Brillouin scattering in ferroelectric lithium niobate (LiNbO3) was investigated. A complete set of elastic, piezoelectric and photoelastic constants appropriate for the hypersonic frequency range is presented. A high resolution rating spectrograph using photographic techniques was employed in the determination of the elastic and piezoelectric constants. From the measured Brillouin shifts, the velocities of the scattering phonons were calculated for different crystal orientations and orthogonal polarizations. The photoelastic constants (Pockels' coefficients) were determined from intensity ratios among the Brillouin components. These ratios were obtained using a scanning monochromator in conjunction with a photon counting system. From the experimentally observed intensity ratios and theoretical intensity expressions, the photoelastic constants were computed. Dissert. Abstr.

N71-24940# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ADJUSTMENT OF OPTICAL DEVICES
M. M. Rubinov 18 Dec. 1970 508 p refs Transl. into ENGLISH of the book "Yustirovka Optich. Priborov" Moscow, Izd.-vo Nedra, 1969 p 1-326
(AD-719773; FTD-MT-24-119-70) Avail: NTIS HC $6.00/MF $0.95 CSCL 20/6

The book is dedicated to an examination of various kinds of errors which appear in the process of assembly of various optical instruments and the means of elimination of these errors. For the purpose of generalization and systematization of the material the first part of the book presents different geometrical diagrams of optical instruments; the second and third parts are dedicated to general questions from the theory of optical instruments and to effect of prisms and mirrors; the fourth and last part considers the adjustment of separate characteristic elements of optical systems and the assembly and adjustment of most important optical instruments on the whole. Furthermore, the basis of calculation of allowances for separate optical parts are given. Author (GRA)

N71-24982# Maryland Univ., College Park. Center for Theoretical Physics.
THE PROPOSED CP AND ISOSPIN VIOLATING INTERACTION AND SYMMETRIES OF THE THREE TRIPLET MODEL
Jogesh C. Pati Apr. 1971 36 p refs
(Grant NSF GP-8748)
(TR-71-103) Avail: Issuing Activity

The previously made proposition that there exists a basic nonelectro-magnetic interaction at the level of electromagnetism, which violates isospin, C, CP and T invariance maximally is reconsidered. It is found that the notion of this new interaction acquires several desirable features in the framework of the three triplet model. They are: (a) the construction of partially conserved Delta S = Delta Q = 0, C-even and C-odd vector currents entering into the interaction; (b) the suppression of CP violation compared to isospin violation due to the new interaction and (c) the possibility of large contribution from the new interaction to the Delta I = 1 mass differences without appreciable contribution to the Delta I = 2 mass splittings. The eta yields 3 pion-problem does not seem to have any simple solution in the present model if vector form is required for the new interaction. The possible advantages of a scalar form for the said interaction from considerations of the eta yields 3 pion-decay and the signs of the Delta I = 1-mass differences are noted. Author

N71-24999# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Experimentelle Kernphysik.
MEASUREMENTS ON PULSED SUPERCONDUCTING MAGNETS
K. P. Juengst, G. Krafft, and G. Ries May 1970 13 p refs Presented at 3d Intern. Conf. on Magnet Technol., Hamburg, 19-22 May 1970
(KFK-1217; CONF-700503-8) Avail: AEC Depository Libraries

Several experiments with superconducting multifilament NbTi wires were performed to measure ac losses, degradation effects, and reachable H, in order to find a suitable conductor for an ac dipole. Solenoids were built with NbTi multicore wires having the following parameters: composite diameter 0.04 to 0.1 cm, Cu and Cu/CuNi (3-component) matrix, twist rate between 0.5 and 2 turns/cm, filament diameter 13 to 48 micrometers. The solenoids typically had an inner diameter of 2.5 cm, an outer diameter of 8.5 cm and a length of 5.5 cm, yielding a central field between 40 and 72 kG. The solenoids were not potted and reached 85 to 90% of short-sample critical current. For the chosen cooling conditions, a maximum H was reached of 95 kG/sec with a field amplitude of 52 kG. The measured ac losses agree with theoretically predicted ones. Significant additional self field losses could not be confirmed quantitatively. Author (NSA)

N71-25036# Maryland Univ., College Park. Center for Theoretical Physics.
REPLY TO ASYMPTOTIC SU(3) SYMMETRY: NONVALIDITY OF INTERMULTIPLET MASS FORMULAS
S. Oneda and Seisaku Matsuda (Polytech. Inst. of Brooklyn, N.Y.) Apr. 1971 11 p refs Submitted for publication
(Grant NSF GP-8748)
(TR-71-100) Avail: Issuing Activity

Evidence is presented to support the validity of a procedure used in deriving quadratic intermultiplet mass formulas. Criticism based on the usual formal counting of the order of SU(3) breaking is consider to be nonrelevant. D.L.G.

N71-25040# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Nuclear Labs.
[NUCLEAR PHYSICS AND SOLID STATE RESEARCH, AND SOLID STATE RADIATION DETECTORS] PHYSICS DIVISION Progress Report, 1 Oct.–31 Dec. 1969
31 Dec. 1969 100 p refs
(AECL-3666) Avail: AEC Depository Libraries; Atomic Energy of Can., Ltd., Chalk River; $2.00

Studies made by the nuclear physics branch, the general physics branch, the neutron physics branch, the theoretical physics branch, and the mathematics and computation branch of the physics division at Atomic Energy of Canada Limited in the period Oct. 1 to Dec. 31, 1969 are briefly described. Author (NSA)

N71-25071 Stanford Univ., Calif.
HIGH EFFICIENCY VOLUME HOLOGRAPHY
Richard Alan Baugh (Ph.D. Thesis) 1969 138 p
Avail: Univ. Microfilms Order No. 70-10422

The diffraction efficiency and image distortion properties of loss-less volume transmission holograms are investigated. In order to solve the problem it is necessary to find an approximate solution to Maxwell's wave equation in an inhomogeneous dielectric. The inhomogeneity in the dielectric constant and the electric field within the dielectric are expressed as plane wave expansions. The eigenfunctions for the inhomogeneous dielectric are obtained by reformulating the wave equation as a self-adjoint matrix operator. The eigenvectors and eigenvalues of this operator are then obtained via degenerate perturbation theory. This method gives an accurate expression for the intensity of the diffracted image, angle sensitivity, and higher order Bragg diffraction. The spurious waves diffracted out of the hologram are obtained by solving a scattering integral which is the first iteration in an exact integral equation solution to the problem. The principal source of image distortion in a volume hologram is low frequency spatial modulation. Dissert. Abstr.

N71-25143# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON A COMPUTATION OF THE ENERGETIC RESPONSE OF INFRARED SCANNING APPARATUS
N. F. Soboleva 1971 3 p refs Transl. into ENGLISH from Opt. Mekh. Prom. (Leningrad), v. 37, no. 10, 1970 p 9–11
(AD-719847) Avail: NTIS CSCL 17/5

A general formula is derived to determine the energetic response of an infrared scanning apparatus. A graphical interpretation of the obtained formula is given which is useful for engineering computations. Author (GRA)

N71-25151# Northwestern Univ., Evanston, Ill. Dept. of Physics.
THE MAGNETIC IMPURITY PROBLEM IN METALS Final Scientific Report
Lawrence B. Welsh Feb. 1971 7 p refs
(Grant AF-AFOSR-1762-69)
(AD-719862; AFOSR-TR-71-0250) Avail: NTIS CSCL 20/12

A detailed study of the Kondo state as a function of magnetic field and temperature in CuFe and related alloy systems is reported. The temperature and magnetic field dependence of the copper isotope 63 linewidth and longitudinal relaxation time as a function of the FE concentration are measured. A study of exchange enhancement and spin fluctuations in dilute alloys using nuclear magnetic resonance techniques is reported. The alloy system of LaSn3(1-x)In(3x) shows possible strong exchange enhancement effects. The effects of exchange enhancement on the spin fluctuations are studied by measuring the nuclear longitudinal relaxation times of lanthanum. Author (GRA)

N71-25168# Parke Mathematical Lab., Inc., Carlisle, Mass.
ACOUSTIC RADIATION PROBLEMS Final Report, 1 May 1967–31 Jan. 1971
Charles H. Sherman and John L. Butler Jan. 1971 19 p
(Contract N00014-67-C-0424)
(AD-719726; Rept-0424-FR) Avail: NTIS CSCL 20/1

The final report reviews the work which was done under the contract on the analysis of noise radiated from submarines and other acoustic field problems. The review is followed by a discussion of possible applications and extensions of the work which might have value in naval problems. A complete list of publications is included. Author (GRA)

N71-25175# Georgetown Univ., Washington, D.C. Dept. of Physics.
MODE CONVERSION OF ULTRASONIC WAVES AT FLAT INTERFACES Final Technical Report, 1 Nov. 1965–31 Oct. 1970
Walter G. Mayer Feb. 1971 16 p refs
(Contract Nonr-5037(01))
(AD-719937; TR-6) Avail: NTIS CSCL 20/1

The generation of ultrasonic surface waves during beam reflection from liquid-solid interfaces is discussed. Conditions are given under which the surface wave is created on isotropic and anisotropic solids. Methods are described by which the amplitude, velocity and absorption of the surface wave can be measured using optical probes. Critical angle reflectivities and resulting crystal orientation possibilities are discussed. Author (GRA)

N71-25176# Texas Univ., Austin. Applied Research Labs.
NONLINEAR ACOUSTICS
T. G. Muir Dec. 1970 140 p refs Presented at Navy Underwater Sound Advisory Group Conf., Austin, Texas, 10–11 Nov. 1969
(Contract N00014-70-A-0166-0001)
(AD-719936) Avail: NTIS CSCL 20/1

Ten theoretical and experimental papers are presented on research problems in nonlinear acoustics. Topics include: the history of nonlinear acoustics, finite-amplitude effects in underwater acoustics, self-demodulation of acoustic waves, multidimensional finite-amplitude waves in gases, finite-amplitude processes in ducts, transient effects associated with large-amplitude acoustic pulses, virtual sources in the presence of real sources, transient effects in parametric arrays, parametric oscillations in resonant systems, and the scattering of sound by sound. Publication is sponsored by the U.S. Navy Office of Naval Research. Author (GRA)

N71-25321*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
USE OF COHERENT OPTICS FOR ONBOARD DATA PROCESSING
James P. Strong, III *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 275–280 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 20F

Etched silicon solar cell ring detectors are described that provide coherent optics of cloud covers by measuring distance and angle of information from the center of their Fourier transforms; this method establishes whether a picture is made up mostly of small scattered clouds or mostly of large clouds. Ring patterns etched on the silicon solar cell surface of the radius detector measure the intensity of light at various distances, and the sectors in the angle detectors detect concentrations of light along a line at various angles; graphs provide detector outputs when placed in the Fourier transform plane. G.G.

N71-25421# Lamont Geological Observatory, Palisades, N.Y.
[OCEAN BOTTOM ACOUSTIC PROPERTIES AT SONAR FREQUENCIES] Final Report, 12 Feb. 1969–30 Apr. 1970
George M. Bryan 30 Apr. 1970 17 p refs

(Contract N00024-69-C-1184)
(AD-719935) Avail: NTIS CSCL 8/10

The research was part of a continuing program in which the Observatory has investigated acoustical properties of the sea floor relevant to long-range sonar performance in the oceans. The principal objective is the prediction of acoustic bottom loss at sonar frequencies as a function of geographical position. The bottom-reflected acoustic path is of paramount importance in present-day long range sonar systems and bottom loss is the crucial factor in determining the usefulness of this path. Thus it is essential to predict levels of bottom loss in areas where long-range sonar is to be used. Author (GRA)

N71-25453# California Univ., Livermore. Lawrence Radiation Lab.

TORMAG: A PROGRAM FOR SYMMETRY OPTIMIZATION OF TOROIDAL MAGNETS

O. A. Anderson and Dieter Fuss 1 Oct. 1970 7 p refs Sponsored in part by AEC
(UCRL-50944) Avail: NTIS

The TORMAG code, which finds by a direct computation the optimum segment currents for low field ripple in a toroidal magnet with access gaps, is described. In a sample calculation, the code is applied to a T3A Tokamak-geometry magnet. With three segments, field ripple is reduced from 4% to 0.1% without increasing the maximum current density or reducing access; the aspect ratio is actually improved to 4.4:1. TORMAG should be useful in the design of future strong-field machines, such as Tokamaks or the proposed relativistic pinch machine. Author (NSA)

N71-25463# California Univ., San Diego.

THERMAL RESISTANCE BETWEEN POWDERED CERIUM MAGNESIUM NITRATE AND LIQUID HELIUM AT VERY LOW TEMPERATURES

W. C. Black, A. C. Mota, J. C. Wheatley, J. H. Bishop, and P. M. Brewster 1970 13 p refs
(Contract AT(04-3)-34)
(UCSD-34-P-143-35) Avail: NTIS

Experiments were performed from magnetic temperatures of 2 to 20 m K on the effects of minute He-4 impurities and a magnetic field on the thermal boundary resistance between powdered cerium magnesium nitrate (CMN) and liquid He-3. The thermal resistance decreases with decreasing T and increasing small field but is increased dramatically at a given T by the addition of roughly a monolayer of He-4. The resistance is interpreted as resulting from a surface magnetic coupling between CMN and liquid He-3. Author

N71-25517# Cornell Univ., Ithaca, N.Y. Lab. of Atomic and Solid State Physics.

INFLUENCE OF TWO BODY POTENTIAL ON THE GROUND STATE PROPERTIES OF SOLID HELIUM

Jean-Pierre Hansen Dec. 1970 7 p refs Sponsored by AEC
(NYO-3699-50) Avail: NTIS

The wrong volume dependence of calculated solid Helium ground-state properties is shown to be due, at least partly, to the inadequate choice of the inter-atomic pair potential. NSA

N71-25518# Massachusetts Inst. of Tech., Cambridge. Francis Bitter National Magnet Lab.

CONSIDERATION OF THE THERMAL PROPERTIES OF MATERIALS IN THE DESIGN OF TRANSIENTLY STABLE SUPERCONDUCTING MAGNETS

J. R. Hale [1971] 23 p refs Sponsored in part by AFOSR
(Contract AT(30-1)-3700)
(MIT-3700-13) Avail: NTIS

A method of analyzing the transient thermal behavior of a section of magnet winding using a computerized model was described previously. The previous study is extended here to include a number of interleaving materials, the use of both copper and silver as the normal metal component of the conductor, and the use of thin, inorganic insulation. NSA

N71-25519# Stanford Univ., Calif. Inst. for Plasma Research.

NOTE ON APPLICATION OF WHITHAM'S METHOD TO NONLINEAR WAVE INTERACTION IN DISPERSIVE MEDIA

K. B. Dysthe Nov. 1970 23 p refs
(Contract AT(04-3)-799; Grant NSF GK-16717)
(SU-IPR-396) Avail: NTIS

A method, developed by Whitham for obtaining equations governing the slow variation of finite amplitude wavetrains, is modified and applied to the study of nonlinear interaction of waves in a dispersive medium. The relevant equations describing the slow variation of the interacting waves are derived. An equation describing the so-called self-action effect of a finite amplitude wave is also derived, and as an application, the stability of such a wave is studied. Author (NSA)

N71-25600# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

SURFACE PROPERTIES OF MAGNETIC MATERIALS
Progress Report, 1 Mar. 1969 – 31 May 1970

E. J. Scheibner 1970 36 p refs
(Contract AT(40-1)-2755)
(ORO-2755-25; PR-10) Avail: NTIS

Research on electron interactions with solid surfaces and the characterization of contamination on surfaces is reported. Theoretical work on plasmon excitations and the Auger emission problem is discussed. The development of an experimental means of calibrating the sensitivity of the Auger spectroscopy data by combining these measurements with work function data obtained on the same system is described. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N71-24364# Army Electronics Command, Ft. Monmouth, N.J.

LARGE omega ASYMPTOTIC EXPANSIONS AND PERTURBATION THEORY FOR THE HARMONIC OSCILLATOR

G. R. Osche and G. J. Iafrate Dec. 1970 38 p refs
(AD-719272; ECOM-3368) Avail: NTIS CSCL 20/10

In Part I, a large parameter asymptotic expansion of a perturbed simple harmonic oscillator is presented. Perturbations of the form lambda (x sup alpha) are studied where lambda is the coupling constant. The method is demonstrated by a general derivation of the wave functions to third order for any alpha and quantum number n. Additional expressions are presented for the ground states to tenth order in the energy. It is also shown that the matching condition for the basic and perturbation theory solutions is automatically satisfied due to the non-singular nature of the perturbation. In Part II, the solution to the Schrodinger equation for a one dimensional harmonic oscillator under the influence of two general classes of potentials is investigated using high-order perturbation theory. It is shown that by utilizing a finite expansion of the perturbation theory wave function in terms of Hermite polynomials, perturbation theory results can be readily obtained, for any state, to arbitrarily high order. Author (GRA)

N71-24365# Northeastern Univ., Boston, Mass. Dept. of Physics.
THE QUANTUM BIANCHI IDENTITIES AND FIELD EQUATIONS FOR GENERAL RELATIVITY
M. Russo Dec. 1970 29 p refs
(Contract F33615-69-C-1207)
(AD-718957; NUB-2042) Avail: NTIS CSCL 20/10

By invoking the physical symmetry of coordinate invariance for the matter-free gravitational field, the contracted quantum Bianchi identities are derived from a family of Hermitian Lagrangians which are the quantum analogues of the Palatini Lagrangian. It is further shown that these gauge variational techniques yield a set of necessary conditions that determine whether the quantum field equations and contracted Bianchi identities contain purely quantum structures of order (Plancks constant/2pi) squared which possess no quantum analogues. Author (GRA)

N71-24473# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d-Etudes Nucleaires.
PROGRAM POKER: DESCRIPTION AND UTILIZATION
Jeanne-Marie Lanore Dec. 1970 24 p refs In FRENCH
(CEA-N-1388) Avail: AEC Depository Libraries

The Monte Carlo Code Poker allows the calculation of the propagation of polyenergetic neutrons in a plane or spherical geometry. It is particularly adapted to the problem of deep penetrations. The theoretical principles of the biasing method, the description of the code, and some advice on its use are given. Author (NSA)

N71-24474# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Reaktorentwicklung.
INVESTIGATIONS OF THE DIFFUSION OF Li-6 FROM IRRADIATED BERYLLIUM OXIDE [UNTERSUCHUNGEN ZUR DIFFUSION VON LITHIUM-6 AUS BESTRAHLTEM BERYLLIUMOXID]
Heinz Dieter Roehrig Jul. 1970 123 p In GERMAN
(JUL-677-RG) Avail: AEC Depository Libraries

Investigations on Li-6 diffusion from irradiated BeO are reported. The measurement methods and apparatus developed were described. The measurement results obtained are given and interpreted. The release isotherms determined indicate a pattern deviating sharply from the normal diffusion behavior. A semiempirical formula with which the measured curves could be quantitatively described was derived. The time constants of the texture changes obtained from the release curves are in qualitative agreement with the measured changes in density and the open porosity. Author (NSA)

N71-24475# Kernforschungsanlage, Juelich (West Germany).
DIFFERENT MODELS FOR CALCULATION OF NUCLIDE TRANSPORT IN CLAD SPHERICAL FUEL PARTICLES FOR HIGH TEMPERATURE REACTORS [VERSCHIEDENE MODELLE ZUR BERECHNUNG DES NUKLIDTRANSPORTS IN KUGELFOERMIGEN UMHUELLTEN BRENNSTOFFTEILCHEN FUER HOCHTEMPERATURREAKTOREN]
Karl-Wilhelm Baurmann Aug. 1970 73 p refs In GERMAN
(JUL-685-PA) Avail: AEC Depository Libraries

Various models for nuclide transport in multiple clad spherical fuel particles (coated particles) were developed. The coefficients which describe the transient starting behavior of the transport were developed to solutions. These solutions correspond to that of a semi-infinite expanding transport range and were represented in the form of Gauss error integrals which guarantee a sufficient convergence of the solutions. The solutions for the long term behavior have the form of infinite series. In the treatment of the boundary conditions a time constant concentration transition on the surface of two transport media flowing by each other and an evaporation coefficient on the particle surface were considered. The differential equations describing the transport problem were treated with the help of the Laplace transformation in the subregion. It is recommended to solve numerically the differential equations when the number of transport ranges exceeds two. Author (NSA)

N71-24532*# California Univ., Livermore. Lawrence Radiation Lab.
POST IRRADIATION MICROANALYSIS
E. D. Albrecht, J. M. Johnson, and W. N. Hayes, Jr. *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 466-470 refs Sponsored by AEC (See N71-24501 13-22)
Avail: NTIS HC $9.00/MF $0.95 CSCL 18H

A technique for examining 0.20-in.-diam by 0.75-in.-long irradiated fuel specimens was developed. Several pieces of specialized apparatus for decladding, subdividing, and analyzing these specimens are described or referenced, and a systematic procedure is given for dimensional measurement, and chemical and metallographic analysis of such specimens. Author

N71-24534*# Battelle-Northwest, Richland, Wash.
DAMAGE FUNCTION ANALYSIS OF NEUTRON ENERGY AND SPECTRUM EFFECTS UPON THE RADIATION EMBRITTLEMENT OF STEELS
C. Z. Serpan, Jr. and W. N. McElroy *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 491-505 refs Sponsored in part by ONR (See N71-24501 13-22)
(Contracts AT(49-5)-2110; AT(45-1)-1830)
Avail: NTIS HC $9.00/MF $0.95 CSCL 18J

Models describing neutron damage in reactors were adjusted with data on mechanical property changes of A302-B steel irradiated at < 450 F. This procedure yielded a damage function that more properly accounts for the energy dependence of damage. One major conclusion reached is that detailed as well as accurate neutron dosimetry measurements of fast and thermal fluxes, corrected to reactor operating temperatures, are necessary if good correlations among irradiation-effects data are to be obtained. This requirement applies to both experimental irradiations and irradiations at reactor component surveillance locations. The study has shown further that an independently derived damage function for irradiation of structural steels such as A302-B at < 450 F is realistic and can be applied to new experimental data conforming to those conditions. The contributions of thermal and low-energy neutrons to the embrittlement process in low-alloy steel are shown to be of major importance to the interpretation of radiation-effects data. Author (NSA)

N71-24535*# Los Alamos Scientific Lab., N.Mex.
USE OF NUCLEAR EXPLOSIONS FOR THE STUDY OF RADIATION DAMAGE PROCESSES
Robert L. Carter *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 506-515 refs Sponsored by AEC Prepared in cooperation with Missouri Univ., Columbus (See N71-24501 13-22)
Avail: NTIS HC $9.00/MF $0.95 CSCL 18G

Information and theory are presented to support the thesis that the effects of high intensity neutron irradiation on the physical properties of solids can be investigated in underground nuclear explosions. Discussions are included on the use of nuclear explosions, character of a nuclear bomb as a neutron source, mechanical problems of testing, parameters of radiation damage and annealing experiments, and parameters of direct energy conversion studies. NSA

N71-24537*# Battelle Memorial Inst., Columbus, Ohio.
SOME APPLICATIONS OF NEUTRON RADIOGRAPHY IN IRRADIATION TESTING TECHNOLOGY
J. W. Ray *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 533-539 (See

N71-24501 13-22)
(Contract W-7405-eng-92)
Avail: NTIS HC $9.00/MF $0.95 CSCL 18H

The efficiency of neutron radiography in providing high quality radiographs of highly radioactive specimens has led to its use in irradiation testing technology at several installations. It has been used routinely in conjunction with irradiation programs for about four years. The principal applications of neutron radiography in determining fuel specimen dimensional changes periodically during irradiation and in examination of experimental assemblies to determine the integrity of key components are described. Author (NSA)

N71-24561*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
EXAMINATION OF RETURNED SURVEYOR 3 CAMERA VISOR FOR ALPHA RADIOACTIVITY
Thanasis E. Economou and Anthony L. Turkevich *In its* [Lunar Surface Mater. Analyses] 31 Mar. 1971 16 p refs (See N71-24558 13-30)
Avail: NTIS CSCL 18H

The Surveyor 3 camera visor brought back by the Apollo 12 astronauts has been examined for an alpha radioactive deposit formed by the decay of radon isotopes diffusing out of the lunar surface. An upper limit for the equilibrium amount of Po-210 at Oceanus Procellarum has been set at less than 0.005 dis/sq cm/sec. This number is appreciably lower than the amount of Po-210 observed by Surveyor 5 at Mare Tranquillitatis. Author

N71-24574# Institute of Nuclear Physics, Krakow (Poland).
ON THE SPECTRUM OF RESONANCES IN THE GENERALIZED VENEZIANO MODEL
Jens Bjorneboe Sep. 1970 35 p refs
(INP-730) Avail: AEC Depository Libraries

The spectrum of resonances with definite spin in the generalized Veneziano model is determined. Explicit formula for the coupling of all normal parity resonances to all channels are given. A set of selection rules for two body reactions is found. Author (NSA)

N71-24575# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
APPARATUS FOR INVESTIGATION OF ALPHA ACTIVE NUCLEI: THE PRODUCTS OF THE REACTIONS WITH HEAVY IONS
I. V. Kolesov, Yu. Y. Lobanov, and V. M. Plotko 1970 22 p refs In RUSSIAN
(JINR-P13-5353) Avail: AEC Depository Libraries

An apparatus is described for investigation of alpha-active short-lived products of nuclear reactions induced by heavy ions. Recoil nuclei after stopping in a gas are collected on the fibrous filters, passed through by a gas stream (the collection coefficient is 40 to 70%) and are transferred, periodically, to two pairs of Si–Au detectors. The collectors are operated by pneumatic drive. The minimal transfer time is 0.02 s. The apparatus has the possibility of recording two series alpha-decays (parent and daughter nuclei). Author (NSA)

N71-24576# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
SYSTEM OF PROPORTIONAL WIRE CHAMBERS ON LINE WITH A COMPUTER
Yu. V. Zanevskii, T. S. Nigmanov, V. D. Peshekhonov, V. P. Pugachevich, and M. Turala 1970 11 p ref In RUSSIAN
(JINR-P13-5473) Avail: AEC Depository Libraries

A system of two proportional wire chambers on-line with a computer or analyzer is described. Results obtained by operating the system in the 4.03 GeV/c negative pion beam are presented. Author (NSA)

N71-24579# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SCATTERING BY TWO CENTERS IN LONG WAVE APPROXIMATION
I. A. Eganova and M. I. Shirokov 1970 23 p refs In RUSSIAN
(JINR-P4-5438) Avail: AEC Depository Libraries

Using the two point functions, constructed previously, the scattering of a slow scalar particle by potentials of small radius separated by an arbitrary distance R is considered. It is shown that the multiple scattering approximation in the case, when the scattering phases are small, is valid even if the requirement kR much greater than 1 is not imposed (hk is the particle momentum). Author (NSA)

N71-24671# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
SIMPLIFIED METHOD OF OBTAINING INFORMATION FROM BUBBLE CHAMBER PHOTOGRAPHS AND THE USE OF AUTOMATIC SELECTION TECHNIQUES [METHODE SIMPLIFIEE DE MESURE DE CLICHES DE CHAMBRE A BULLES ET SELECTION AUTOMATIQUE]
Jacques Bouchez, Francoise Cadiet, Adrienne Fabie, and Laurens Georges Dec. 1970 28 p In FRENCH
(CEA-N-1397) Avail: AEC Depository Libraries

A simplified method of obtaining information from bubble chamber photographs is presented. This method allows geometric and kinematic reconstruction followed by automatic selection. It was used to study the pion(−)p yields pion(−) pion(+) N reaction. This simplified method has been used with the HPD automatic measurement apparatus. Author (NSA)

N71-24672# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
ANISN SYSTEM: DESCRIPTION AND USE OF THE DISCRETE ORDINATE PROGRAM ANISN AND OF THE AUXILIARY PROGRAMMES
Christian Devillers Oct. 1970 124 p refs In FRENCH
(CEA-N-1358; Rept-1) Avail: AEC Depository Libraries

Most of the data required for using the ANISN program (discrete ordinates) and the auxiliary programs, in the case of problems relating to one dimensional transport of neutrons and gamma rays, are given. Detailed explanations concerning the preparation of the data and the cross section library pre-processing are given and are illustrated by examples. The principle of the numerical method used by ANISN is presented in an appendix. Author (NSA)

N71-24685# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
STUDY OF THE EFFECTIVE MASS SPECTRA OF THE GAMMA GAMMA, PION(0) GAMMA, PION(0) GAMMA GAMMA, PION(0) PION(0), PION(0) ETA-MESON(0), PION (0) PION (0) GAMMA, PION (0) PION (0) PION (0) SYSTEMS IN THE MASS VALUE REGION M (GAMMA...GAMMA) < or = 1.3 GeV
Z. S. Strugal'skii, I. V. Chuvilo, T. Gemesy, I. A. Ivanovskaya, Z. Jablonski et al 1970 45 p refs
(JINR-E1-5349) Avail: AEC Depository Libraries

The production and decays of neutral bosons decaying into neutral pions and gamma quanta were searched in a xenon bubble chamber exposure to a 2.34 GeV/c positive pion beam. Interactions of the type positive pion + n yields X + p, where n is a quasi-free neutron in the xenon nucleus and X is any particle decaying into neutral pions and gamma quanta, were studied. Among the produced neutral bosons studied are the f(0), eta meson(0), and omega meson(0). NSA

N71-24686# Institute of Nuclear Research, Warsaw (Poland).
PROTON PROTON AND PION PROTON INELASTIC COLLISIONS AND THE PROTON AND PION FORM

FACTORS
R. Sosnowski and W. Wojcik 1970 13 p refs
(INR-P-1229) Avail: AEC Depository Libraries

A model of proton – proton inelastic collisions at high energies is proposed. It assumes that the amplitude for a collision in which n secondary particles are produced is a product of n form factors identical with the charge form factor of the proton. The predictions of the model are compared with the experimental data. The main characteristics of the experimental distributions of secondary particles are well reproduced by the model. The experimental data on high energy pion – proton collisions are also compared with the prediction of the model. Author (NSA)

N71-24687# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
RESONANCE PARAMETERS FOR MEASURED keV NEUTRON CAPTURE CROSS SECTIONS
A. R. de L. Musgrove Aug. 1970 60 p refs
(AAEC/E-198-SUPPL-1) Avail: AEC Depository Libraries

All available neutron capture cross sections in the keV region (approximately 5 to 100 keV) were fitted with resonance parameters using a nonlinear least squares fitting routine. Graphs of s-, p- and d-wave neutron strength functions are given. An appendix gives calculated best fits compared with experiment. Author (NSA)

N71-24697# Institute of Nuclear Physics, Krakow (Poland).
STATISTICAL MODEL AND CROSS SECTIONS FOR HIGH ENERGY REACTIONS
Jerzy Bartke 1970 68 p refs
(INP-719) Avail: NTIS

Application of the statistical model to the calculation of cross sections for high-energy reactions is discussed. Comparison with the data includes branching ratios for various reaction channels within a given multiplicity and the energy dependence of partial cross sections. The obtained results indicate the usefulness of the statistical model approach to the analysis of high-energy reaction cross sections. Author (NSA)

N71-24698# Democritus Nuclear Research Center, Athens (Greece).
NEW DERIVATION OF AN APPROXIMATE EXPRESSION IN CLOSED FORM FOR THE BINDING ENERGY OF AN IMPURITY PARTICLE IN NUCLEAR MATTER
M. E. Grypeos Sep. 1970 6 p refs
(DEMO-70/20) Avail: AEC Depository Libraries

A new derivation is given of an approximate expression in closed form for the binding energy of an impurity particle in nuclear matter. The advantage of this new derivation, in which no use is made of any cluster expansion, is that it is simpler than the original one. Author (NSA)

N71-24699*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTRON BOMBARDMENT ION SOURCE OPERATION USING VARIOUS GASES
D. C. Byers and P. D. Reader 1971 15 p refs Presented at 11th Symp. on Electron Ion and Laser Beam Technol. Sponsored by Inst. of Elec. and Electron. Engr., Am. Vacuum Soc., and Colo. Univ., Boulder, Colo., 12 – 14 May 1971
(NASA-TM-X-67831) Avail: NTIS CSCL 20H

A flight type SERT 2 thruster operation results with xenon, krypton, argon, neon, nitrogen, helium, and carbon dioxide are presented. Magnetic spectrometer data were taken with some of the gases to determine the ion species ejected from the source. Author

N71-24802# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
COMMENT ON THE ELASTIC NN AND Nd SCATTERING
O. V. Dumbrais 1970 7 p refs
(JINR-P2-5444) Avail: AEC Depository Libraries

The ratios are obtained connecting the product and difference of alpha sub p n values with the differential and total cross sections of pn- and pp-scattering. It is shown, on this basis, how the term proportional to the product alpha sub pn alpha sub pp in the Glauber correction in pd-scattering can be precisely estimated. Author (NSA)

N71-24852# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
EXPERIMENTAL IONIZATION CHAMBER FILLED WITH LIQUID AND SOLID ARGON
L. B. Golovanov, V. D. Ryabtsov, E. A. Silaev, and A. P. Tsvinev 1970 12 p refs In RUSSIAN
(JINR-P13-5404) Avail: AEC Depository Libraries

A plane-parallel ionization chamber filled with liquid and solid argon is described. The results of investigations of ionization processes in argon are presented. All of the ionizations are collected in solid argon tested in a relativistic negative pi meson beam. NSA

N71-24859# Japan Atomic Energy Research Inst., Tokai. Div. of Physics.
PROCEEDINGS OF THE THIRD CONFERENCE ON INELASTIC NEUTRON SCATTERING, TOKAI, 1969
Mar. 1970 117 p refs In ENGLISH and JAPANESE Conf. held 6-8 Dec. 1969
(JAERI-1197; CONF-691219) Avail: AEC Depository Libraries

Two main subjects of the conference were collective excitations in disordered and magnetic systems and lattice dynamics of high-polymer substances. A collection of the papers presented at the conference and records of the discussion are documented. Author (NSA)

N71-24860# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
TEST OF SU3: SYMMETRICAL STATISTICAL THEORY OF ELEMENTARY PARTICLE PRODUCTION
H. M. Beshtojev 1970 8 p refs In RUSSIAN
(JINR-P2-5480) Avail: AEC Depository Libraries

The calculations performed previously were repeated and compared with new experimental data. The best agreement of calculations with experiment was obtained at lambda = 0.0407. The calculation results are close to the experimental ones with the exception of data for channels with a small number of particles, where the statistical approach is not applied. Author (NSA)

N71-24898# Oak Ridge National Lab., Tenn.
NEUTRON ELASTIC- AND INELASTIC-SCATTERING CROSS SECTIONS FOR Mg IN THE ENERGY RANGE 4.19 TO 8.56 MeV
W. E. Kinney and F. G. Perey Jun. 1970 49 p refs
(Contract W-7405-eng-26)
(ORNL-4550) Avail: NTIS

Numerical values are presented for neutron elastic scattering cross sections for natural Mg and cross sections per atom of natural Mg for inelastic scattering to levels in Mg-24 for incident neutron energies from 4.19 to 8.56 MeV. The data are in good agreement with the results of others. ENDF/B evaluated Mg angular distributions are in fair agreement with the data. The ENDF/B total elastic scattering cross section agrees well with the experiment below 5 MeV, but at higher energies it is generally higher than the data, the difference being as much as 40%. The ENDF/B total inelastic scattering cross sections are in good agreement with the experimental data. Author (NSA)

N71-24899# Oak Ridge National Lab., Tenn.
NEUTRON ELASTIC- AND INELASTIC-SCATTERING CROSS SECTIONS FOR Co IN THE ENERGY RANGE 4.19 TO 8.56 MeV
W. E. Kinney and F. G. Perey Jun. 1970 105 p refs
(Contract W-7405-eng-26)
(ORNL-4549) Avail: NTIS

Numerical values of neutron elastic and inelastic scattering cross sections for natural Co, Co-59, in the incident neutron energy range from 4.19 to 8.56 MeV are presented. The results are in reasonable agreement with the results of others. Because of the high level density of Co, data at all energies of measurement are listed as angle-averaged continuum spectra which show structure previously seen in Fe and Ni-60. Author (NSA)

N71-24900# General Electric Co., Schenectady, N.Y. Knolls Atomic Power Lab.
ELECTRON MULTIPLIERS AND STATISTICS OF SECONDARY ELECTRON EMISSION
L. A. Dietz [1970] 26 p refs Presented at the 18th Ann. Conf. on Mass Spectrometry and Allied Topics, San Francisco
(Contract W-31-109-eng-52)
(KAPL-P-3879; CONF-700607-1) Avail: NTIS

The electron multiplier detector is discussed mainly as it is used in the pulse-counting mode and some of its advantages and limitations are pointed out. The secondary electron multiplication process is described in terms of a Polya statistical model and its generality is demonstrated by fitting it to a wide range of shapes of observed pulse-height distributions. The Polya model shows how the target or conversion dynode dominates the statistical behavior of an entire detector. Using an Al2O3 target surface, preliminary measurements of secondary electron yield as a function of ion mass, impact velocity and angle of entry were made. These results are described. Practical considerations in using electron multipliers in either the dc or pulse-counting modes are mentioned. Author (NSA)

N71-24901 Florida State Univ., Tallahassee.
A THEORETICAL STUDY OF THE SPATIAL AND VELOCITY DISTRIBUTION OF ELECTRONS ORIGINATING FROM A POINT SOURCE IN A NEUTRAL GAS AND ACTED UPON BY A HOMOGENEOUS dc ELECTRIC FIELD
Robert David Mitchell 1969 149 p
Avail: Univ. Microfilms Order No. 70-11145

The thirteen moment approximation is used to determine the spatial and velocity distribution of electrons in a drift tube and a diffusion chamber. The electrons are assumed to originate from a point source in a neutral gas and to be acted upon by a homogeneous dc electric field. Expressions are obtained for the electron density, electron drift velocity, and electron temperature as functions of the position in the chamber, the electron current, the electric field strength, and the electron-molecule cross sections. These solutions are compared with the results of experiments. Dissert. Abstr.

N71-24969 Texas A&M Univ., College Station.
UNRESTRICTED HARTREE-FOCK ATOMIC WAVEFUNCTIONS
Lindsay Flynt Phillips (Ph.D. Thesis) 1969 88 p
Avail: Univ. Microfilms Order No. 70-11570

Unrestricted Hartree-Fock (UHF) wavefunctions, in the Spin-Polarized Hartree-Fock (SPHF) approximation, were determined for a number of neutral, divalent, and trivalent transition metal atoms with d(N) electronic configurations. Only ground state terms were considered. One electron, spin-orbit, and spin-spin parameters are reported as well as the hyperfine structure (hfs) Fermi contact term for each atom. The contact term, plotted as a function of increasing atomic number for a given ionicity, shows a maximum for those ions having a d(5) configuration. Comparisons of restricted Hartree-Fock and SPHF calculations of the spin-orbit and spin-spin parameters for neutral atoms reveal that major differences occur for those atoms having a more than half filled d shell. Dissert. Abstr.

N71-25029 Maryland Univ., College Park.
A STUDY OF THE GENERAL RELATIVISTIC DYNAMICS OF THE KLEIN-ALFVEN COSMOLOGY
Barry Kyler Moritz (Ph.D. Thesis) 1969 162 p
Avail: Univ. Microfilms Order No. 70-10291

The dynamic equations for proton-antiproton annihilation cosmology are derived, and the relevant cross sections and energy momentum transfer are determined in the general relativistic magnetohydrodynamic scheme. The equations were programmed for high speed digital computers in certain simplified approximations. The results indicate that the Klein-Alfven cosomology cannot explain the observed matter content of at least 10 to the 54th power grams, as the contracting ambiplasma will not reexpand for masses of this order. The actual magnitude of the electron positron annihilation cross section is reexamined and shown to be of critical importance in this cosmological model, as the radiative recombination process, which had previously been ignored, is much more efficient than the direct interaction. Although the nucleon annihilation rate is enhanced, the lepton rate goes up even faster, resulting in a decrease in the net radiation forces contributing to a turnaround. Dissert. Abstr.

N71-25030 Rutgers Univ., New Brunswick, N.J.
STUDY OF K(+) DECAYS INTO THREE PIONS
Anatol Zinchenko (Ph.D. Thesis) 1969 116 p
Avail: Univ. Microfilms Order No. 70-10111

Samples of 144 tau' events and 5428 tau events were obtained from an exposure of 150,000 pictures to a stopping kaon(+) beam in a 30 in. propane bubble chamber. Since each tau' event included at least one pion(0) reconstructed from electron-pairs in addition to a stopping pion(+), a fitting procedure completely determines the kinematics of the tau' decay. It was found that the kaon 3 pion decay amplitude for either mode is linear in the energy of any one of the three pions and that the experimental linear slopes are consistent in magnitude with theoretical linear slopes predicted by soft-pion limits in current algebra; no distinction can be made between delta I = 1/2 and delta I = 3/2 predictions with the statistics. However, the combined world data does not agree well with the delta I = 1/2 predictions. Phenomenological I-spin analysis predicts the ratio of the tau' and tau slopes for a pure I = 1 three pion state. The slope values averaged over all major experiments indicated that the kaon 3 pion final state is not pure I = 1. Dissert. Abstr.

N71-25041 Stanford Univ., Calif.
THE STUDY OF HIGH ISOSPIN STATES BY ISOSPIN FORBIDDEN RADIATIVE CAPTURE REACTIONS
Kurt Albert Snover (Ph.D. Thesis) 1969 109 p
Avail: Univ. Microfilms Order No. 70-10528

The low-lying T = 2 levels in several light, self-conjugate nuclei were investigated by means of isospin forbidden radiative capture reactions. Proton particle capture reactions have been investigated in the vicinity of the lowest T = 2 states of C-12, Ne-20, Mg-24 and S-32, and both proton and alpha particle capture reactions into Si-28 have been studied in the vicinity of the lowest two T = 2 levels. In addition, alpha-induced charged particle reactions were studied in the immediate vicinity of the lowest T = 2 level in Si-28. The excitation energy measurements are discussed in terms of Coulomb energy calculations and the quadratic mass formula, and are used in computations of masses of missing members of the isobaric multiplets. The measured radiative decay strengths and branching ratios are discussed and compared to theoretical calculations. The isospin forbidden radiative and particle decays are discussed, along with a qualitative model for the later. Dissert. Abstr.

N71-25044# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

SEARCH FOR A NEW TYPE OF RADIOACTIVITY IN ALUMINUM AND TUNGSTEN TARGETS IRRADIATED BY 70-GeV PROTONS

A. V. Dem'yanov, A. V. Kulikov, A. V. Kuptsov, G. G. Mkrtchyan, L. L. Nemenov et al 1970 11 p refs In RUSSIAN
(JINR-P1-5399) Avail: AEC Depository Libraries

A method was previously proposed suitable for searching for hypothetical quasi-stable elementary particles which might be produced in high energy collisions. The method is based on the idea that such particles may be trapped in nuclear matter and thereby originate a new type of radioactivity characterized by a comparatively high energy of its disintegration products (tens of MeV or more). The first results are given of a search for a radioactivity with the emission of high energy gamma quants from targets irradiated for a long time by 70 GeV protons at Serpukhov. Lifetimes in the range from one day to several years were considered. The experimental set up consists of three scintillation counters, an optical spark chamber, a water Cherenkov counter and a total absorption glass Cherenkov spectrometer. The pulses from all the detectors were fed to a five-beam oscilloscope for the time-amplitude analysis. No events with gamma emission were observed. Author (NSA)

N71-25091# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Festkoerper und Neutronenphysik.

MEASUREMENT OF STORED ENERGY IN ELECTRON IRRADIATED PLATINUM BELOW 40 K [MESSUNG DER GESPEICHERTEN ENERGIE AN ELEKTRONENBESTRAHLTEM PLATIN UNTERHALB 40 K]

Klaus Feese Apr. 1970 47 p refs In GERMAN
(JUL-658-FN; D-82) Avail: AEC Depository Libraries

After irradiation with 3-MeV electrons at temperatures below 10 K the stored energy released in the annealing of the radioinduced Frenkel pairs was measured between 15 and 40 K. For values in the order of magnitude of the integral stored energy to be expected in irradiation, a total measurement uncertainty of + or − 8% was obtained. The recovery curves measured after irradiation of the 20 micrometer thick Pt foils showed systematic deviations from that observed by other authors in resistance recovery. These deviations corresponded to a supplementary energy release increasing steadily with temperature. The uncertainty given can be traced principally to the uncertainty of the energy release caused by subthreshold irradiation. The effective cross section of defect production was calculated for 3-MeV electrons on Pt. By use of a theoretical estimated value for the formation energy of a Frenkel pair in Pt of 6 eV, the value of the effective cross section of defect production was (50 + or − 25)b. Author (NSA)

N71-25093# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

MEASUREMENTS OF THE DEPOLARIZATION PARAMETER D FOR ELASTIC PROTON SCATTERING

R. Beurtey, P. Catillon, and P. Schnabel [1970] 2 p refs Presented at the 3d Intern. Symp. on Polarization Phenomena in Nucl. Reactors, Madison, Wis., 31 Aug.−4 Sep. 1970
(CEA-CONF-1650; Conf-700811-4) Avail: AEC Depository Libraries

An investigation was made of the conditions for which the depolarization paramater (D) is significantly different from unity, even when the spin-flip contribution is small. Measurements were made at scattering angles corresponding to the minima of the elastic scattering cross section. The beam of polarized protons was scattered by a target with a nonzero spin. D was measured for Al-27 (I = 5/2), B-10) (I =3),and Be-9(I = 3/2); the results are 0.964 + or − 0.021, 0.962 + or − 0.011 and 0.940 + or − 0.016, respectively. Another measurement on Si-28 (I = 0) at 18.0 MeV gave a value of D = 1.027 + or − 0.025, consistent with the theoretical value of unity. NSA

N71-25094 Indiana Univ., Indianapolis.

EIGENFUNCTION EXPANSIONS FOR SCATTERING IN TWO PARTICLE AND THREE PARTICLE SYSTEMS: AN APPROACH TOWARD OBTAINING EXACT SOLUTIONS OF THE FADDEEV EQUATIONS

Michael Oran Marcoux (Ph.D. Thesis) 1969 84 p
Avail: Univ. Microfilms Order No. 70-10269

A method of solving a set of Faddeev equations is proposed wherein sufficiency conditions on the interactions are stated to achieve an exact separable decomposition of the kernels. This converts the integral equations to matrix equations which can then be routinely solved. The separable decomposition is equivalent to Weinberg-s quasi-particle method for a three particle system in which a single pair interaction is absent. Finally, an attempt is made to formulate the quasi-particle problem in a manner that can be practically solved. An infinite set of coupled ordinary differential equations in two variables is proposed along with integral boundary conditions on the amplitudes. Alternately, a single integro-differential equation is stated which can be viewed as a perturbation on the schrodinger equation. Dissert. Abstr.

N71-25108# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

OPTIMIZATION OF ION SOURCE AND ION OPTICAL PARAMETERS OF THE ISOTOPE SEPARATOR IN THE YASNAPP-1-FACILITY

A. Piotrowski, V. I. Raiko, and H. Tyrroff 1970 16 p refs In RUSSIAN
(JINR-P13-5369) Avail: AEC Depository Libraries

The operating conditions that give the highest possible efficiency and resolving power for an isotope separator of the ISOLDE type are given. A magnetron ion source with end extraction along the magnetic field lines of a cylindrical ion beam and a 4-electrode system for the ion beam formation were used. By measuring the dependence of the opening angle theta for the ion beam and the resolution power of the mass-lines at the collector for the accelerating voltage U sub alpha = 25 kV and U sub alpha = 40 kV −on the ion current for various values of the extraction voltage U sub e, the distance between the electrodes d and the diameter of the exit hole, it was confirmed that: the highest possible resolving power is to be obtained only for a certain value of the opening angle theta = theta sub opt. The behavior of the resolving power on the ion current is explained by the pulsation of the ion current density in the plasma discharge and by the amplification process of these pulsations in the ion beam via the strong dependence theta (I). Author (NSA)

N71-25109# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Energii.

OBSERVATION OF ANTI He-3 [NABLYUDENIE ANTIGELIYA 3]

Yu. M. Antipov, N. K. Vishnevskii, and Yu. P. Gorin 1970 31 p refs In RUSSIAN
(IFVE-SEF-70-16) Avail: AEC Depository Libraries

Antihelium 3 nuclei were observed in the negative beam, produced by 70-GeV protons on an AL target. Five antihelium 3 were identified among 2.4-10 to the 11th power particles that passed through the apparatus. Scintillation and Cerenkov counters were used to measure electrical charge and velocity of particles. Author (NSA)

N71-25110# California Univ., Santa Barbara. Dept. of Physics.

HIGH ENERGY USER GROUP AT SANTA BARBARA Progress Report, May 1969 − Mar. 1970

David O. Caldwell Mar. 1970 13 p ref
(Contract AT(11-1)-34)
(UCSB-34-P-135-12) Avail: NTIS

Research on high-energy physics experiments by the Santa Barbara users group is reported for the period from May 1969 to March 1970. NSA

N71-25111# Comissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

MEASUREMENT AND MICROSCOPIC CALCULATIONS OF THE CROSS SECTIONS AND ASYMMETRIES FOR THE (PROTON, PROTON PRIME) REACTION EXCITING THE 2.31 MeV (0 +, T = 1) STATE OF N 14

J.-L. Escudie, A. Tarrats, and J. Raynal 1970 2 p refs Presented at 3d Intern. Symp. on Polarization Phenomena in Nucl. Reactions, Madison, Wis., 3 Aug.–4 Sep. 1970

(CEA-CONF-1651; CONF-700811-6) Avail: NTIS

Experimental evidence was obtained of nonresonant contributions to the (N-14)(p,p') reaction at 24 MeV. Good fits could not be simultaneously obtained for both asymmetries and cross sections. A tensor force was found to be necessary to fit the cross section data. Experimental knowledge about the asymmetries removed important ambiguities in the nature of the force used and indicated the necessity of a spin–orbit term. The introduction of a nonscalar interaction necessitated the revision of the mixing generally chosen for the scalar potential. NSA

N71-25112# European Organization for Nuclear Research, Geneva (Switzerland). Div. of Nuclear Physics.

METHOD OF MEASUREMENT OF THE BEAM PROFILE FOR HIGH INTENSITY PARTICLES (10 to the 12th power/sq cm) [METHODE DE MESURE DU PROFILE D'UN FAISCEAU POUR DES INTENSITIES ELEVEES DE PARTICULES (10 to the 12th power/sq cm)]

H. Annoni (Centre Rech. Nucl., Strasbourg), A. Cordaillat, A. J. Herz, O. Mendola, and R. Oppel (Centre Rech. Nucl., Strasbourg) 13 Oct. 1970 12 p refs In FRENCH

(CERN-70-27) Avail: AEC Depository Libraries

This method allows a rapid and precise determination of the beam profile, the position of the maximum of the intensity and the absolute intensity (with an error of about 10%). It can be used for intensities between 10 to the 11th power and 2 × 10 to the 12th power particles sq cm. Thin plastic detector foils (cellulose nitrate) are exposed normal to the beam under study and the measurements are carried out with a microdensitometer. Nuclear-research emulsions were used as a comparison standard. The first measurements were carried out in a proton beam of energy 600 MeV; the method can be applied to any other kind of high-intensity, high-energy beam. Author (NSA)

N71-25129*# Pittsburgh Univ., Pa. Dept. of Physics.

ENERGY SPECTRA OF METASTABLE OXYGEN ATOMS PRODUCED BY ELECTRON IMPACT DISSOCIATION OF O2

W. L. Borst and E. C. Zipf Dec. 1970 26 p refs Submitted for publication

(Grant NGL-39-011-030; Contract DA-31-124-ARO(D)-440) (NASA-CR-118336; SRCC-150) Avail: NTIS CSCL 20H

Kinetic energies of metastable O atoms formed in dissociative excitation of O2 were measured in a time of flight experiment. Metastable O(5SO) atoms (9.14 eV) as well as high lying states near the ionization limit of O(13.6 eV) were detected by means of Auger ejection of secondary electrons from a Cu-Be surface. The energy spectra of metastable fragments showed distinct structure with maxima near 0.3 and 2 eV. Repulsive potential energy curves of O2 were constructed from the measured energy spectra and time-resolved excitation functions. The excitation function for the direct excitation of the O(5SO) state had a threshold of (14.3 + 0.2) eV which is equal to the minimum energy for dissociatively exciting the O(5SO) state. Using selection rules and symmetry arguments concerning the angular variation of dissociation products, the molecular state reached near 14.3 eV was identified as Pi u state with a probable multiplicity of 3. Other molecular states reached at higher energies were not identified. Several atmospheric applications of the measurements concerning the heating of the atmosphere, radiative transfer of resonance radiation, and chemical reactions are mentioned briefly. Author

N71-25144# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung.

BEHAVIOR OF FISSION PRODUCT Mo, Tc, Ru, Rh, and Pd IN A CARBIDE FUEL ELEMENT AND STRUCTURE OF THE SYSTEM Mo-Ru-C

H. Holleck Sep. 1970 31 p refs In GERMAN; ENGLISH summary

(KFK-1260) Avail: AEC Depository Libraries

From the fission product elements Mo, Tc, Ru, Rh, and Pd the metals Mo and Ru have been taken as typical and most frequent examples to investigate the behavior of alloys of the above elements with carbon. Temperature-sections of the phase diagram Mo–Ru–C are given for 2000, 1500, and 1100 C. There exists a fcc high temperature phase. The homogeneous region of this phase becomes larger with increasing temperature. The existence of certain types of binary or ternary phases in systems with the components Mo, Tc, Ru, Rh, Pd, and C is discussed. The stability of phases occurring in the Mo–Ru–C system has been estimated, i.e., calculated assuming ideal solution. The occurring phases are too unstable to prevent a reaction of the fission products Mo and Ru with UC. Author (NSA)

N71-25160 Kansas Univ., Lawrence.

A STUDY OF DOPPLER BROADENED GAMMA RAYS RESULTING FROM THE Na-23(PROTON, ALPHA GAMMA) Ne-20 REACTION

Werner Joseph Stark (Ph.D. Thesis) 1969 101 p

Avail: Univ. Microfilms Order No. 70-11090

Arguments are made showing that the pulse-height distribution resulting from Doppler broadened gamma rays depends on the alpha-gamma angular correlation. This correlation was determined at several resonances from an analysis of the pulse-height distribution. Supplementary information on the possible spin and parity and the mixing parameters was obtained from conventional angular distribution measurements at each resonance. The results show that this method was successful in finding the spin and parity of several states in Mg-24 in the energy range 12.7 < E sub x < 13 MeV. Three previous spin and parity assignments were confirmed and new assignments were made at three resonances. In addition, information of orbital angular momentum of the protons in the formation process and the alpha-particles in the decay were obtained for all the states investigated. Dissert. Abstr.

N71-25161# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

RESONANT SCATTERING OF LIGHT BY LIGHT

Z. Kunszt, R. M. Muradyan, and V. M. Ter-Atonyan 1970 8 p refs

(JINR-E2-5424) Avail: AEC Depository Libraries

Resonant scattering of light by light due to exchange of C-even mesons, such as pion and eta-mesons, is considered. The total cross section for gamma gamma scattering at a resonance point s = m (2) sub pi has the value sigma sup pi = (16 pi/m (2) sub pi) is approximately 1.1 × 10 to the minus 24th power sq cm. Assuming 2% energy resolution, the cross section has the magnitude 10(-30) is approximately 10(-31) sq cm. It is shown that the cross section for the reaction gamma gamma yields pion(+) pion (–) near f(1260) resonance has the value 10 to the minus 29th power sq cm. Author (NSA)

N71-25162# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.

MEASURE OF THE FACTOR OF FAST FISSION 'epsilon' IN A D2O URANIUM LATTICE [MISURA DEL FATTORE DE FISSIONE VELOCE 'epsilon' IN RETICOLI A D2O URANIO NATURALE]

F. Rustichelli and G. Maracci 1969 52 p refs In ITALIAN
(EUR-4326) Avail: AEC Depository Libraries

An analysis of the different definitions of the fast fission factor epsilon is first performed. Then the method of measurement used in the determination of the fast fission ratio delta(28) in ORGEL heavy water natural U lattices is described. Such a method is based on the integral gamma, counting of irradiated U detectors. A description is then given of the back to back fission chamber which has been built in order to determine the calibration factor P(t). Finally the experimental values of delta(28) obtained at different pitches are compared with the theoretical data of PINOCCHIO code; the agreement is satisfactory. The reported values for epsilon were calculated by using the OLDEKOP theory. Author (NSA)

N71-25163# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.

ODAC: A FORTRAN 4 PROGRAMME TO PROCESS A TIMOC LIBRARY FROM THE ENDF/B FILE

H. Krainer 15 Jun. 1970 52 p refs
(EUR-4521-e) Avail: AEC Depository Libraries

The processing of nuclear data from standard cross section libraries is of particular importance for Monte Carlo programs which can handle a large number of nuclear input parameters. the CODAC code is designed to produce these parameters from the ENDF/B data file in the form of group averaged cross sections and scattering models. The output formats of CODAC agree with the input specifications of the Monte Carlo code TIMOC. With this code one has the possibility to obtain group averaged data for special, problem orientated group limits. CODAC is written in FORTRAN 4 for an IBM 360/65 using no programming tricks and nearly no machine features, so that it will run, except for minor modifications, on any other machine which is large enough. For the sake of saving computer space, it is built up in an overlay structure. CODAC uses the retrieval subroutines developed by H. C. Honeck and parts of the ETOM-ETOG code. Dissert. Abstr.

N71-25164# Comision Nacional de Energia Atomica, Buenos Aires (Argentina).

CORRECTIONS FOR DEAD TIME IN DETECTION EXPERIMENTS ON NUCLEAR STATISTICS [CORRECCIONES POR TIEMPO NUERTO EN EXPERIENCIAS DE DETECCION SOBRE ESTADISTICAS NUCLEAIRES]

C. Castro Madero, R. Corcuera, and H. Schilman 1969 16 p refs In SPANISH
(CNEA-262) Avail: AEC Depository Libraries

Corrections for the dead time to be used in nuclear detection experiments were obtained. A probability analysis of the problem was made beginning with the possible distinct states in a detection system. The correlations of states of the system, responsible for the loss of counts, are corrected comparing the probabilities of the distinct stages. The formalism is then applied to the two most important statistics in nuclear detection: Poisson statistics and binominal negative statistics. Its application to some experiments, such as that of neutron correlation, is immediate. The precision of the expressions obtained were verified experimentally in studies on the Poisson distribution. The chi square test showed the present formulation to be more exact than that of Pacilio. The p correction parameter was determined experimentally for a large number of conditions and the results show the validity of the theoretical hypotheses. Author (NSA)

N71-25165# Royal Aircraft Establishment, Farnborough (England.)

THE NATURE OF THE ELECTRICAL PULSE OF AN EXPLOSION [O PRIRODE ELEKTRICHESKOGO IMPULSA VZRYVA]

M. E. Gertsenshtein et al Nov. 1970 13 p refs Transl. into ENGLISH from Zh. Prikl. Mekh. Tekh. Fiz. (Moscow), v. 2, 1970 p 72-75
(RAE-Lib-Trans-1528) Avail: NTIS

An examination is made of the mechanism of formation of an electrical pulse during detonation of ordinary explosive substances. A double electrical layer having a potential difference of the order of approximately 0.2 - 0.6 V per kT is formed in the detonation wave. When the detonation wave reaches the surface of the charge adhesion of the electrons to the molecules of the products of the explosion and air takes place. During scattering of the charged products of the explosion the distance between the positive and negative charges increases, and the voltage increases to a magnitude of the order of a kilovolt. Asymmetrical scattering of the charged products of the explosion is in fact the cause of the pulse. The theoretical estimates are compared with the experiment. Author

N71-25173# Junta de Energia Nuclear, Sacavem (Portugal). Lab. de Fisica e Engenharia Nucleares.

WESTCOTT FORMALISM [FORMALISMO DE WESTCOTT]

H. Machado Jorge 1969 49 p refs In PORTUGUESE
(LFEN-NI.-45-a) Avail: AEC Depository Libraries

Neutron capture by a material in a well-moderated nuclear reactor is divided into a thermal portion and a 1/E portion. Westcott developed a prescription for the rate that requires a ratio and a gradual cut-off function, Delta, of the fluxes in the two parts, and the deviation from 1/v capture in the material that arises from resonance capture. This review of the prescription gives the formulas for the calculation of the several functions that are needed, presenting the Delta sub 4 function in the form of both table and graph. The range of validity of the formalism is indicated. Author (NSA)

N71-25174# European Organization for Nuclear Research, Geneva (Switzerland).

MAIN DECAY CHARACTERISTICS OF MERCURY ISOTOPES AND THEIR DAUGHTER PRODUCTS (182 < OR = < OR = 192)

M. Finger, R. Foucher, J. P. Husson et al 3 Nov. 1970 53 p refs
(CERN-70-29) Avail: AEC Depository Libraries

Isotopically pure mercury isotopes and their radioactive daughter products in the mass range 182 to 192 were produced. As part of the nuclear spectroscopic investigations of these nuclides, information was gathered on half-lives of ground states and some excited states, on gamma-ray energies and intensities, and on conversion-electron energies and intensities, by the use of high-resolution detectors. Simplified decay schemes are also presented. NSA

N71-25177# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

INELASTIC SCATTERING OF POLARIZED PROTONS BY Ca 40 AT 24.5 MeV

J. L. Escudie, J. Gosset, H. Kamitsubo, and B. Mayer 1970 2 p refs Presented at 3d Intern. Symp. on Polarization Phenomena in Nucl. Reactions, Madison, Wis., 31 Aug.-4 Sep. 1970
(CEA-CONF-1858; Conf-700811-9) Avail: AEC Depository Libraries

The asymmetry of the inelastic scattering of polarized protons by Ca-40 was measured. A beam energy of 24.5 MeV was used to reduce contribution from nondirect reactions. The experimental results and the DWBA macroscopic predictions are given. The calculated asymmetry is fairly sensitive to the optical potential parameters, which were determined from the simultaneous fitting of both elastic scattering cross section and polarization measurements. Calculation with the full Thomas term gave satisfactory results for the first 3(-) state. However, the same calculation gave an inferior

fit for the 5(−) state and failed completely for the second 3(−) state. The microscopic calculation at 20.3 MeV using the wave functions of Gillet and Sanderson showed reasonable agreement for the asymmetry in the 5(−) state at 4.48 MeV but not in the 3(−) state at 3.73 MeV. These facts suggest that the 3(−) state at 3.73 MeV is quasi-collective, contrary to the 5(−) state at 4.48 MeV. NSA

N71-25178 Stanford Univ., Calif.
MICROWAVE-OPTICAL INVESTIGATIONS OF Cr (3+) PAIRS IN RUBY
Michael John Berggren (Ph.D. Thesis) 1969 83 p
Avail: Univ. Microfilms Order No. 70-10425

The techniques used were ordinary electron spin resonance, optically detected electron spin resonance, and high resolution optical spectroscopy. The ESR spectrum was reexamined especially for possible resonances in the isolated regions of the spectrum that had not been fully investigated before. No suitable candidates were found and it is concluded that the analysis of the complex ESR spectrum is indeed formidable. However, it was discovered that a new technique of optical detection of electron spin resonance could be applied to the fourth nearest neighbors. From a study of these resonances it is shown that the splittings of the ground state energy levels of the fourth nearest neighbors can be described by a spin Hamiltonian. A simple theory is described which gives the dependence of D sub S, E sub S and the axis of symmetry upon S, the total spin of the pair, requiring only two adjustable parameters: D sub C, the second order axial crystal field term, and D sub E, the axially symmetric anisotropic exchange term. Dissert. Abstr.

N71-25182# Democritus Nuclear Research Center, Athens (Greece).
HERETRA: A COMPUTER PROGRAM FOR FISSION PRODUCTS CALCULATIONS
J. Antoniades and E. Mavroyannakis Mar. 1970 9 p refs
(DEMO-70/10) Avail: AEC Depository Libraries

A computer program is given which can be used for the calculation of the concentration of fission products. Author (NSA)

N71-25197 Cornell Univ., Ithaca, N.Y.
A STUDY OF THE SPIN-ORBIT SPLITTING IN NUCLEI NEAR CLOSED SHELLS
Robert R. Scheerbaum (Ph.D. Thesis) 1969 268 p
Avail: Univ. Microfilms Order No. 70-8677

The spin-orbit component of the shell model potential arising from the effective two-nucleon spin-orbit force is derived in the Hartree-Fock approximation. The derivation applies to the interaction of a nucleon with a spin-saturated core of nucleons. The method employed makes use of the extreme short range character of the two-nucleon force to obtain an expansion of the one-body potential in powers of the relative coordinate. The shell model potential is used to calculate the contributions, from their spin-saturated cores, to the spin-orbit splitting of various levels in nuclei near closed shells. The splittings are calculated for three nuclear models: (1) the spherical harmonic oscillator shell model, (2) a Fermi distribution describing the nucleons in the spin-saturated core and pure harmonic oscillator wave functions describing the outer nucleon, and (3) the results of a realistic Brueckner-Hartree-Fock calculation describing all the nucleons. Significant differences between these models are found. The effect of the higher moment terms in the expansion is discussed and arguments are presented as to the theoretical validity of the expansion in the range of the two-body interaction. Dissert. Abstr.

N71-25206# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
STUDY OF (p,d) REACTIONS ON CA 48 AND TI 49 WITH POLARIZED PROTONS
J. L. Escudie, J. Gossett, H. Kamitsubo, and B. Mayer 1970 2 p refs Presented at 3d Intern. Symp. on Polarization Phenomena in Nucl. Reactions, Madison, Wis., 31 Aug. – 4 Sep. 1970
(CEA-CONF-1655; Conf-700811-8) Avail: AEC Depository Libraries

The (Ca-48)(p,d)Ca-47 and (Ti-49)(p,d) Ti-48 reactions were induced with polarized proton beams at 22.9 MeV and 20.9 MeV, respectively. Cross sections and asymmetries were measured for transitions leading to the ground states Ca-47 and Ti-48 and also to the first excited state of Ti-48. The spin and parity of Ca-47 were deduced. In the case of the (Ca-48)(p,d)Ca-47 reaction the stripping peak is at about 30 deg, the asymmetry is positive, and the total angular momentum transferred is j = 7/2. DWBA predictions are given for j = 5/2 and J = 7/2. The shape of the cross-section angular distribution is well reproduced, but the DWBA results do not give the correct ratio for the cross section at backward and forward angles. The optical-potential parameters were calculated to fit both cross section and polarization in the proton channel and cross section in the deuteron channel. NSA

N71-25225# Comision Nacional de Energia Atomica, Buenos Aires (Argentina).
GAMMA-GAMMA COINCIDENCES IN Ce 140
E. Y. de Aisenberg and A. N. Proto-Otero 1970 17 p refs In SPANISH
(CNEA-275) Avail: AEC Depository Libraries

Coincidence spectra from Ce-140 were measured with NaI(Tl) 3 in. × 3 in. crystals. The (398-2348) and (868-920) keV gamma-gamma coincidences were established. Two new levels at 2746 and 3348 keV are then proposed. Author (NSA)

N71-25242 Michigan State Univ., East Lansing.
SIMULTANEOUS ANALYSIS OF THE FIRST POSITIVE BAND SYSTEM OF N2 IN THE NEAR INFRARED EXCITED BY A HOLLOW CATHODE DISCHARGE
Lamar Eugene Bullock (Ph.D. Thesis) 1969 188 p
Avail: Univ. Microfilms Order No. 70-9504

A flowing gas, doubled-ended, water-cooled hollow cathode discharge tube has been designed and constructed to operate in a longitudinal magnetic field. This source was used to excite the first positive system of N sub 2, and high resolution spectra of the bands between 1 and 1.5 microns were recorded. Two sets of simultaneous constants and their 95% simultaneous confidence intervals are given and discussed. One set came from the analysis of the near infrared data presented here and the other from the analysis of energy level data found in the literature. A vibrational dependence of the spin-orbit coupling constant A and the spin-splitting constant Lambda are calculated. Computer programs were written to calculate and identify the transition frequencies and to perform a least squares fit of the theory to the experimental data. A complete description of their function and use is included. Dissert. Abstr.

N71-25246# Purdue Univ., Lafayette, Ind. Dept. of Physics.
A STUDY OF THE REACTIONS PION(+) PROTON YIELDS PION(+) KAON(+) KAON(−) AND PION(+) PROTON YIELDS PION(+) PROTON PROTON ANTIPROTON AT 13.1 GeV/c
T. A. Mulera, C. R. Ezell, J. A. Gaidos, J. W. Lamsa, and R. B. Willman [1970] 9 p refs Presented at 15th Intern. Conf. on High Energy Physics, Kiev, USSR Sponsored by AEC
(COO-1428-223; CONF-700808-9) Avail: NTIS

Events corresponding to the reactions pion(+) proton yields pion(+) proton kaon(+) kaon(−) and pion(+) proton yields pion(+) proton proton antiproton were selected from a 230,000 picture pion(+) exposure at 13.1 GeV/c in the 82 in. SLAC bubble chamber. The events were selected by the technique of forced balance of the unfitted energy and momentum. The first reaction is

dominated by the production of K*0 (890) and N* ++ (1236). Production of the K sub N (1420) is also observed. Enhancements in the K(+)K(−) mass spectrum are observed at 1030 and 1240 MeV. The second reaction is dominated by N* (1236) production. The enhancement reported at 3755 MeV in the ppp mass spectrum is not observed. Author (NSA)

N71-25248# European Atomic Energy Community, Geel (Belgium). Central Nuclear Measurements Bureau.
[NUCLEAR MEASUREMENTS, TECHNOLOGY, PHYSICS, AND ASSAYING] ANNUAL PROGRESS REPORT, 1969
1970 72 p refs
(EUR-4525; EUR-FF-11) Avail: AEC Depository Libraries

The different activities of the Central Bureau for Nuclear Measurements during the year 1969 are described. The progress and trends of the research program are presented together with a description of the operational, service and administrative activities of the Laboratory. Author (NSA)

N71-25253# Atomic Energy Commission Research Establishment, Riso (Denmark).
[DR2 COMPUTER CONTROL, NUCLEAR GEOPHYSICAL METHODS, AND RESEARCH INSTRUMENTATION] Semiannual Report, 1 Oct. 1969–31 Mar. 1970
Jul. 1970 14 p refs
(RISO-M-1270) Avail: AEC Depository Libraries; on request from Atomenergikommissionens Bibliotek, Risoe, Roskilde, Denmark

Topics include the DR 2 computer system; software for the hybrid computer system; evaluation of uranium reserves in Southern Greenland, field gamma-spectroscopy; determination of rare-earth elements in rock surfaces by X-ray spectrometry; fission track autoradiography; data handling system for the isotope laboratory; measurement of two-phase flow by means of laser techniques; and instrumentation for the cold neutron source in the DR 3. Also, a list of publications and lectures is included. NSA

N71-25254 Fordham Univ., New York.
SECOND QUANTIZED NONRELATIVISTIC TIME-DEPENDENT SCATTERING THEORY, AND A GENERALIZATION OF THE IN-OUT FORMALISM TO INCLUDE COULOMB POTENTIALS
James Robert Klein (Ph.D. Thesis) 1969 311 p
Avail: Univ. Microfilms Order No. 70-11437

The structure of a model second quantized scattering theory describing identical bosons interacting via two-body forces is examined in detail. The role of the asymptotic condition and the type of convergence involved is stressed. The in-put fields are shown to be strong limits of interpolating fields in a precisely defined sense. These interpolating fields are constructed explicitly and are shown to reduce to the usual Heisenberg field operators when Coulomb forces are absent. Difficulties with Coulomb potentials are discussed. It is also shown how one can express certain operators in terms of the in-out fields. In particular, the S-matrix is expressed as an expansion in terms of normal-ordered polynomials in the in-put fields, and S-matrix elements for any scattering process are related to vacuum expectation values of time-ordered products of interpolating fields. Dissert. Abstr.

N71-25255 Rutgers Univ., New Brunswick, N.J.
THREE BODY SECTOR OF STATIC MODELS
Joel Martin Simon (Ph.D. Thesis) 1969 101 p
Avail: Univ. Microfilms Order No. 70-10102

The effect of input resonances on scattering amplitudes which contain three-body intermediate states in static models is investigated. In these models the relationship between bound-states and resonances as a function of the coupling constant is studied. The results of a phase shift analysis are displayed in Argand diagrams. A model is examined for particle-resonance scattering which includes both spin and isospin for which is shown the existence of the Peierl's singularity even when all the rescattering corrections to the Bron graphs are taken into account. The relative effect of the pionN* inelastic threshold and the Peierl's singularity on observable two-body amplitudes satisfying three-body unitarity is also examined. In the scalar Lee model, input resonances are constructed both by the choice of a source function and by the use of a C.D.D. pole. Dissert. Abstr.

N71-25372# Massachusetts Inst. of Tech., Cambridge.
VIBRATIONAL STUDIES OF DINUCLEAR COMPOUNDS CONTAINING QUADRUPLY BONDED PAIRS OF MOLYBDENUM AND RHENIUM ATOMS
W. K. Bratton, F. A. Cotton, M. Debeau, and R. A. Walton (Purdue Univ.) [1970] 39 p refs Sponsored by AEC
(MIT-1965-81) Avail: NTIS

Infrared and Raman spectra were recorded for the following dinuclear ions and molecules containing quadruple metal-to-metal bonds: Re2Cl8(2−), Re2Br8(2−), Mo2Cl8(4−), Re2(O2CCH3)4Cl2, Re2(O2CCH3)4Br2 and Mo2(O2CCH3)4. The Raman data are incomplete due to the intense and extensive electronic absorption spectra of most of the compounds. Intense Raman lines observed at 275 and 289 cm/1 for the rhenium compounds and at 406 cm/1 for Mo2(O2CCH3)4 were assigned as predominantly M-M stretching modes. Vibrational analyses using both valence force fields with a few interaction constants and Urey–Bradley force fields lead to moderately consistent results, with the M-M force constants lying in the range 3.1–4.5 mdyne/A. Author

N71-25373# Instituto de Energia Atomica, Sao Paulo (Brazil). Divisao de Engenharia Quimica.
SPECTROGRAPHIC DETERMINATION OF HAFNIUM IN ZIRCONIUM OXIDE [DETERMINACAO ESPECTROGRAFICA DE HAFNIO EM ZIRCONIO]
Alzira Lourenco Deppe and Antonio Roberto Lordello Apr. 1970 16 p refs In PORTUGUESE; ENGLISH summary
(IEA-208) Avail: AEC Depository Libraries

A method is presented for the quantitative determination of hafnium in zirconium oxide by emission spectrography. The interval of concentration from 2000 to 100 ppM is covered, and a precision of roughly 10% is attained. An oxide sample of 15 mg is topped with graphite powder and is lightly pressed to prevent projection of particles into the plasma column to permit a slow volatilization and to be excited through the 15-A dc arc. Author (NSA)

N71-25374# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
STATISTICAL ISOSPIN MODEL AND CROSS SECTIONS OF THE REACTIONS PION(−) PROTON YIELDS N + (2, ..., 6) PIONS WITHIN 1 TO 16 GeV ENERGY RANGE
V. B. Vinogradov, N. K. Kutsidi, G. Martinska, and L. Shandor 1970 17 p refs In RUSSIAN
(JINR-P1-5471) Avail: AEC Depository Libraries

The ratios between the cross sections of different final charge state of negative pion proton yields nucleon + (2, ..., 6)pions reactions were calculated on the basis of a statistical isospin model. The predictions of the model are compared with the experimental data for these reactions at different energies of incident negative pion-mesons. It is shown that the model predicts the ratios between different charge channels of negative pion proton yields nucleon + (2, ..., 6)pions reactions in the energy range 1 to 16 GeV with an accuracy approximately 10%. Author (NSA)

N71-25382# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
ON j-MIXING DETERMINATION IN (p,d) REACTIONS BY ASYMMETRY MEASUREMENTS

J. Gosset, H. Kamitsubo, and B. Mayer 1970 2 p refs Presented at 3d Intern. Symp. on Polarization Phenomena in Nucl. Reactions, Madison, Wis. 31 Aug.–4 Sep. 1970
(CEA-CONF-1653; Conf-700811-11) Avail: AEC Depository Libraries

The Sn-119(p,d) Sn-118 reaction was studied at 25.5 MeV. Two values are possible for j < j = 3/2 and j = 5/2. The spectroscopic factors S sub 3/2 and S sub 5/2 were calculated from the equations of the cross section sigma and of the asymmetry A. The mean ratio S sub 2/3 / S sub 5/2 was found to be 1.05 + or − 0.18, the contributions of the two orbits d sub 3/2 and d sub 5/2 being nearly equal. The reaction Fe-57(p,d) Fe* was studied at 17.3 MeV. The spectroscopic factors were calculated with a least squares method and the mixing was determined using only cross section measurements. The reaction Ni-61(p,d) Ni*-60 was also studied at 16.6 MeV. The fits between the cross sections, asymmetries, and the determined spectroscopic factors are given. NSA

N71-25385# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics.
THRESHOLD DETECTORS USED FOR THE NEUTRON SPECTRUM MEASUREMENT
K. K. Kosheeva, S. N. Kraitor, and L. B. Pikelner 1970 25 p refs In RUSSIAN
(JINR-P3-5421) Avail: AEC Depository Libraries

Spectrometer characteristics of the threshold detector set U-235, U-235 + Cd, U-235 + 1g/sq cm. B-10, Np-237, U-238 are considered, and the optimal values of the effective cross-sections and the threshold energies for neutron spectra are calculated. The accuracy of the measurements, performed by this set for a number of characteristic spectra, is estimated. Special attention is paid to the measurements below the Np-237 fission threshold. New interpretation of data is proposed that allows the measurement accuracy to be enhanced in this energy region. The construction of the neutron spectrum of the pulsed fast reactor IBR (JINR) are described. Author (NSA)

N71-25402 Washington Univ., Seattle.
APPLICATIONS OF CLUSTER EXPANSION METHODS TO EXTENDED NUCLEAR MIXTURES
George Paul Mueller (Ph.D. Thesis) 1969 160 p
Avail: Univ. Microfilms Order No. 70-10984

The cluster expansion approach is generalized to allow calculations of two strongly interacting components. Examples of these are the alpha particle-nuclear matter mixture, the He-3/He-4 mixture, and the impurity problem, wherein one foreign particle is imbedded in a background of host particles. The formal analysis leading to an expression for the ground state energy of such a mixture was based on the Iwamoto and Yamada (IY) and factorized IY (FIY) cluster expansion techniques. These expressions for the energy are complete through second order in the cluster expansion. The definition of order is based, essentially, on the number of independent short range functions that appear in the integrands of the energy expression. The contributions to the energy of higher orders, particularly the third is investigated. A technique for the numerical evaluation of many dimensional integrals is discussed and then used to estimate the third order contributions to the ground state energy of alpha matter. There is a discussion of the problems arising when conducting cluster calculations. Dissert. Abstr.

N71-25423 Cornell Univ., Ithaca, N.Y.
THE STRUCTURE OF FINITE NUCLEI IN THE LOCAL DENSITY APPROXIMATION
John William Negele (Ph.D. Thesis) 1969 230 p
Avail: Univ. Microfilms Order No. 70-11242

A theory is presented for calculating the structure of finite nuclei from the nucleon-nucleon interaction. The essential features of the reaction matrix in finite nuclei are obtained from nuclear matter theory through the local density approximation. The resulting density and energy dependent effective interaction is justified in detail, and it is shown that the tensor force plays an important role in saturation. The effective interaction is cast into two different forms, one convenient for use in calculating matrix elements and the other specialized for a Hartree–Fock calculation in position space. The results of this theory for O-16, Ca-40, Ca-48, Zr-90, and Pb-208 are shown to yield very satisfactory agreement with experimental binding energies, single particle energies, and electron scattering cross sections. The rearrangement terms in the density dependent theory are demonstrated to have two essential effects on nuclear structure: a significant reduction in the central density of the nucleus, and a modification of the usual Hartree–Fock relation between single particle energies and the binding energy. Equivalent local single particle potentials are calculated and are shown to have significant state dependence. Dissert. Abstr.

N71-25430# Atomics International, Canoga Park, Calif.
AN EVALUATION OF U 235 NEUTRON CROSS SECTION DATA FOR ENERGIES ABOVE 15 keV
H. Alter and C. L. Dunford 20 Jan. 1970 20 p refs
(Contract AT(04-3)-701)
(AI-AEC-Memo-12916) Avail: NTIS

The neutron cross section data for uranium-235 in the energy range 15 keV to 15 MeV were reevaluated. This task was performed in support of the special working group effort directed by the National Neutron Cross Section Center. The need for reevaluating and updating the fissile/fertile nuclide cross section data sets originally prepared for the ENDF/B library was established by the results of Phase 2 data testing. Author (NSA)

N71-25431 Stanford Univ., Calif.
STABILITY OF SUPERFLOW AND ION MOBILITY IN He-3/He-4 MIXTURES
Lorenz Kramer (Ph.D. Thesis) 1969 79 p
Avail: Univ. Microfilms Order No. 70-10479

An attempt is made to explain some recent mobility measurements of ions in dilute He-3/He-4 mixtures and in pure He-3 at very low temperatures. First the general formula for the drag force of a heavy impurity in a gas is derived by a new Boltzmann equation method. The simple theory of a heavy impurity moving through a very rarefied Fermi gas (Knudsen limit) gives only very rough agreement with the experimental results on He-3/He-4 mixtures. Two modifications are introduced. The structure of the negative ion (electron bubble) is assumed to depend on He-3 concentration, and a correction to the Knudsen limit is made. The theory is in fair agreement with the experiments on negative ions for temperatures above about 0.1 K. The application of our theory to pure highly degenerate He-3 shows that the mobility remains finite at T=0 and rises for increasing temperature due to the correction to the Knudsen limit. Both results are in agreement with experiment. Dissert. Abstr.

N71-25432 Carnegie-Mellon Univ., Pittsburgh, Pa.
NUCLEAR STRUCTURE EFFECTS IN THE MAGNETIC HYPERFINE INTERACTION
John Alan Johnson (Ph.D. Thesis) 1970 91 p
Avail: Univ. Microfilms Order No. 70-7332

Nuclear magnetic moments, muon magnetic hyperfine structure, and the hyperfine anomaly are investigated using the pairing interaction and the pairing plus quadrupole model in medium and heavy spherical nuclei. The pairing calculations include three quasi-particle corrections due to a delta force interaction between quasi-particles or between particles in the component of the BCS wavefunction with the correct number of particles. The magnetic moments are well predicted by the models if it is assumed that

meson effects are less than .3 nuclear magnetons. There is not enough experimental data to distinguish the models in muonic hyperfine structure, but the predictions are fair to good in the few measured cases. Much more experimental data exists for the hyperfine anomaly but uncertainties in the electron wavefunctions preclude judging among the models. A method is presented for correcting the calculations for electron shielding and configuration mixing and thus providing a test of electron wavefunctions.
Dissert. Abstr.

N71-25433# California Univ., Berkeley. Lawrence Radiation Lab.
MOLECULAR BEAM KINETICS
David D. Parrish (Ph.D. Thesis) Oct. 1970 244 p refs
(Contract W-7405-eng-48)
(UCRL-19654) Avail: NTIS

An apparatus was constructed to perform magnetic deflection analysis of reactive scattering in crossed molecular beams of neutral species. An inhomogeneous deflecting magnet between the surface ionization detector and the collision zone of the two crossed thermal energy beams was used to distinguish elastic reactant scattering from reactive product scattering by utilizing the large difference in their magnetic dipoles. Studies have been made of the reactions of Li with NO2, CH3NO2, SF6, CCl4, and CH3I. The total reaction cross sections and the reactive attenuations of the wide angle Li elastic scattering for all of these gases are considerably smaller than are the corresponding features previously reported for the reactions of Li + XY (XY = Cl2, Br2 and CII). Backward hemisphere in the CM coordinate system. The features of the NO2 reaction are discussed in terms of the electron transfer mechanism which were advanced to account for the features of the reactions of the alkali atoms with the halogen molecules.
Author

N71-25450# Liege Univ. (Belgium). Lab. d'Application des Radioelements.
TRITIATED TITANIUM TARGETS PRODUCING 14 MeV NEUTRONS. PART 2: STUDY OF MECHANISMS OF THE BEHAVIOR AND NEUTRON OUTPUTS Final Report [SUR LES CIBLES DE TITANE TRITIE PRODUCTRICES DE NEUTRONS DE 14 MEV. PARTIE 2: ETUDE DES MECANISMES DE COMPORTEMENT ET RENDEMENTS NEUTRONIQUES]
M. Guillaume, G. Delfiore, G. Weber, and M. Cuypers Nov. 1970 60 p refs In FRENCH
(EUR-4286-Pt-2) Avail: AEC Depository Libraries

A great number of systematic manufacturing tests of tritiated titanium targets has been performed in order to know the optimal procedure for their preparation and their use with maximum performances under deuteron irradiation. The main factors that determine most of the parameters of a tritiated target are the purity and the thermal conductivity of the titanium layer. Author (NSA)

N71-25473 Texas Univ., Austin.
ISOBARIC ANALOG RESONANCES IN PROTON ELASTIC SCATTERING FROM Cd 110, Cd 112 AND Cd 114
Vitthalbhai Dahyabhai Mistry (Ph.D. Thesis) 1969 132 p
Avail: Univ. Microfilms Order No. 70-10839

Excitation functions were measured for elastic and inelastic scattering of protons from Cd-110, Cd-112 and Cd-114 at proton energies from 6.0 MeV to 11.0 MeV. The isobaric analog resonances observed in In-111, In-113, and In-115 nuclei were analyzed by fitting the elastic excitation functions using a shell model approach to reaction theory to extract quantitative nuclear structure information for the parent analog states in Cd-111, Cd-113, and Cd-115. Spectroscopic factors were evaluated, and their dependence on the choice of optical and bound state potentials was studied. Coulomb displacement energies were also obtained from these data. Comparisons were made with existing (d,p) work on Cd-110, Cd-112, and Cd-114. For most states there is reasonable agreement between the (p,p sub o) and (d,p) results.
Dissert. Abstr.

N71-25474# California Univ., Berkeley. Lawrence Radiation Lab.
COEFFICIENTS OF FRACTIONAL PARENTAGE FOR n yields n MINUS 2 FOR LIKE NUCLEONS
A. A. Ross-Bonney May 1970 18 p
(Contract W-7405-eng-48)
(UCRL-18861) Avail: NTIS

Numerical values and useful recursion relations are given for n yields n-2 coefficients of fractional parentage in the case of like nucleons in j-j coupling. The maximum value of j for which calculations are included is j = 9/2.
Author (NSA)

N71-25475 Cornell Univ., Ithaca, N.Y.
PHOTO- AND ELECTROPRODUCTION OF NEUTRAL RHO MESONS FROM NUCLEI
David Irwin Julius (Ph.D. Thesis) 1969 161 p
Avail: Univ. Microfilms Order No. 70-8671

A comprehensive account of methods involving nuclear targets for the determination of basic parameters describing the coupling of rho mesons to photons and nucleons is presented. A detailed investigation is made of the validity of the closure approximation in neutral rho meson photoproduction from deuterium using a separable potential model of the n-p system. A model is constructed for coherent photoproduction of neutral rho mesons from light nuclei which parallels the Glauber multiple diffraction theory for elastic processes, but which incorporates the substantial modifications. The problem of coherent electroproduction of rhos from heavy nuclei is treated by a simple extension of the Drell-Trefil theory. It is shown how the nucleon helicity non-flip amplitudes for rho-nucleon elastic scattering can be obtained in the usual way from the A-dependence of the forward cross section, and how the corresponding two amplitudes for rho photoproduction can be extracted from measurements of the decay pion angular distribution.
Dissert. Abstr.

N71-25477 Texas Univ., Austin.
FINAL STATE INTERACTIONS IN QUASI-FREE ELECTRON SCATTERING FROM NUCLEI
Chirold Delain Epp (Ph.D. Thesis) 1969 89 p
Avail: Univ. Microfilms Order No. 70-10785

Quasi-free electron scattering from protons bound in nuclei is a powerful tool for the investigation of nuclear structure. Cross sections for the process are calculated using harmonic oscillator and Wood–Saxon potentials to describe the bound state protons. Final state interactions between the outgoing protons and the residual nucleus are included using wave functions calculated from optical model potentials which describe elastic proton scattering. The results of these calculations are compared with experimental data and previous calculations using simpler, less realistic methods of including final state interactions.
Dissert. Abstr.

N71-25481# Los Alamos Scientific Lab., N.Mex.
TRANZIT: A PROGRAM FOR MULTIGROUP TIME DEPENDENT TRANSPORT IN (rho,z) CYLINDRICAL GEOMETRY
K. D. Lathrop, R. E. Anderson, and F. W. Brinkley Dec. 1970 32 p refs
(Contract W-7405-eng-36)
(LA-4575) Avail: NTIS

Finite difference equations are derived for the time-dependent Boltzmann equation in (rho,z) geometry. Generalized weighted diamond difference equations are used to provide recursive solution of the difference equations. A formulation is given for a first

collision source due to an energy-distributed point source on the axis of a system with material properties nonuniform in the z direction. the TRANZIT program to solve the difference equations and (optionally) evaluate the uncollided flux is described. Input and usage instructions for the program are given. Comparisons of calculations with Monte Carlo results are made and used to illustrate typical problem output. Author (NSA)

N71-25482# California Univ., Berkeley. Lawrence Radiation Lab.
DYNAMICAL THEORY OF KIKUCHI ELECTRONS
T. Y. Tan May 1970 4 p refs Presented at the 28th Meeting on Electron Microscopy Soc. of Am., Houston, Tex.
(Contract W-7405-eng-26)
(UCRL-19631; CONF-701003-3) Avail: NTIS

Based on the two beam dynamical theory for elastic electrons, a corresponding theory on the fine structures of the Kikuchi electron intensity distributions in relation to the various diffraction and absorption parameters were formulated. The initial inelastic electron wave amplitudes generated at any position inside the crystal were obtained by considering the decrease in amplitude of elastic electrons due to absorption of the crystal. A scattering matrix similar to that used in dynamical scattering calculations was used to describe the effects upon these newly generated inelastic electrons as they traveled through the crystal. Author

N71-25483# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
MAGNETIC PROPERTIES AND STRUCTURES OF THE CrB COMPOUNDS Tb-Ge(0,2)Si(0,8), HoSi, ErSi, AND TmSi [PROPRIETES MAGNETIQUES ET STRUCTURES MAGNETIQUES DES COMPOSES TB-GE(0,2)SI(0,8), HOSI, ERSI, ET TMSI DU TYPE CRB]
Nguyen Van Nhung, A. Barlat, and J. Laforest 1970 13 p refs In FRENCH; ENGLISH summary Presented at the Intern. Conf. on Magnetism, Grenoble, France, 14–19 Sep. 1970 Prepared in cooperation with Centre Natl. de la Rech. Sci., Grenoble, France
(CEA-CONF-1701; CONF-700940-2) Avail: AEC Depository Libraries

The compounds TbGe(0.2) Si (0.8), HoSi, ErSi, and TmSi of the CrB type are antiferromagnetic below 56, 25, 10, and 10 K, respectively. At 4.2K, HoSi, ErSi, and TmSi are metamagnetic. The configurations of Tb, Ho, and Er moments are colinear; they all have the wave vector = (1/2, 0, 1/2) and belong to the four-dimensional representation associated with this vector. These structures are stabilized by pseudodipolar exchange forces. TmSi has a colinear magnetic structure with a wave vector = (0, 0, 1/2); it belongs to one of the four representations of the space group Cmcm associated with this wave vector. Author (NSA)

N71-25484# Atomic Energy Commission Research Establishment, Lucas Heights (Australia).
PHYSICS OF THE DYNAMIC GROWTH OF MUSHROOM CLOUDS ASSOCIATED WITH NUCLEAR EXPLOSIONS A Bibliography
E. A. Newland, comp. Sep. 1970 8 p refs
(AAEC/LIB/BIB-255) Avail: AEC Depository Libraries

Forty five references are listed, covering the period 1950 to 1969. Arrangement is chronologically by year and alphabetically by author within each year. Where applicable, reference is made to an abstract for each item. NSA

N71-25485# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
SPECTROMETER CHANNEL OF EXPERIMENTAL IONIZATION CHAMBERS WITH THE ARGON AND XENON CONDENSATES
V. D. Ryabtsov and E. A. Silaev 1970 12 p refs In RUSSIAN
(JINR-P13-5402) Avail: AEC Depository Libraries

A spectrometric channel is described, used in the investigations of ionization chambers with xenon condensates. The demands to the spectrometric equipment are formulated taking into account the specific peculiarities of these media. A schematic diagram of the chamber preamplifier is presented. The basic technical characteristics of the channel are given. Author (NSA)

N71-25486# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
AUTOIONIZATION IN THE ULTRAVIOLET PHOTO-ABSORPTION OF ATOMIC CALCIUM Research Report, Jul. 1968–Sep. 1968
Virginia L. Carter, Robert D. Hudson, and Edward L. Breig 19 Feb. 1971 26 p refs
(Contract F04701-70-C-0059)
(AD-719737; TR-0059(9260-01)-11; SAMSO-TR-71-32) Avail: NTIS CSCL 7/4

The study of calcium is of interest because of its solar and astrophysical importance. Also, its photo-absorption spectrum in the uv can be used profitably in the development of theoretical techniques for understanding the general process of autoionization in atomic systems. Results are presented of a combined theoretical and experimental investigation of the absorption spectrum for the allowed dipole transitions singlet S(0) to singlet P(1)(0) of calcium near the first and beyond the second ionization limits. Absorption spectra were obtained experimentally and compared with theoretical calculations. These calculations made allowances for configuration interaction through an analysis of series perturbations in accordance with the multichannel quantum defect theory. Significant improvements have been achieved in the agreement between experiment and the two-channel theory for wavelengths near the ionization threshold, both in the general shape of the absorption profile, and in its magnitude at threshold and at the first resonance peak. Application of the three-channel theory to the latter region is discussed briefly. Author (GRA)

N71-25493# Columbia Univ., New York.
FINITE THEORY OF QUANTUM ELECTRODYNAMICS
T. D. Lee Jul. 1970 35 p refs
(Contract AT(30-1)-1932)
(NYO-1932(2)-183) Avail: NTIS

The treatment of the formulation of a finite theory of quantum electrodynamics covers the indefinite metric and unitarity, the modified photon and fermion fields, Feynman diagrams, experimental consequences, and causality. NSA

N71-25494# Centralny Instytut Informacji Naukowo-Technicznej i Ekonomicznej, Warsaw (Poland).
NUKLEONIKA, VOLUME 14, NO. 9-10
Feb. 1970 138 p refs Transl. into ENGLISH of Nukleonika (Warsaw), v. 14, no. 9-10, 1969 p 885–1036 Supported by AEC and NSF
(AEC-tr-7027/9-10; TT-69-50012/9-10) Avail: NTIS

The basic results of experimental studies conducted on a new type plasma injector (RPI) are presented. The design of the RPI as well as the experimental arrangement are described. The results of measurements using a high-speed camera, magnetic probes, and spectroscopic methods are given. It was proved that, under properly chosen experimental conditions, a strong concentration of plasma can be obtained on the axis of the injector. Author

N71-25495# Wisconsin Univ., Madison.
IMPLANATION INTO FERROMAGNETIC MATERIALS
R. R. Borchers [1970] 53 p refs Conf. on Hyperfine Interactions Detected by Nucl. Radiation, Rehovot and Jerusalem, Israel
(Contract AT(11-1)-Gen-7)
(COO-7-585-7) Avail: NTIS

A survey is presented on implantation into ferromagnetic materials by the Coulomb excitation, perturbed angular correlation (PAC) method, and the determination of hyperfine fields using this method is discussed. Conical fields, transient fields, and g-factors are considered. Examples discussed include Sm isotopes implanted into Cu and Fe by O-16 ions, even isotopes of Ba and Pt, etc. Finally, the use of the PAC implantation technique as a zero energy detector of recoil ions is discussed. NSA

N71-25499# Oak Ridge National Lab., Tenn. Reactor Chemistry Div.
FISSION PRODUCT TRANSPORT AND BEHAVIOR IN THE STAINLESS STEEL LINED CONTAINMENT RESEARCH INSTALLATION (CRI)
G. W. Parker, G. E. Creek, and W. J. Martin Feb. 1971 106 p refs
(Contract W-7405-eng-26)
(ORNL-4502) Avail: NTIS

The tests conducted in the ORNL LOFT Assistance Program to date are summarized for 15 release experiments conducted in the CRI with the stainless steel liner. The experiments are listed in chronological order along with the conditions of the release. The runs included direct release of radioiodine tracer, release of the CSE simulant, fission product release from melted irradiated fuel, and prompt release on cladding failure. These release experiments completed the initial phase of the LOFT Assistance Program, and salient facts are presented concerning those phases of the experiments which are thought to be of most interest. Data concerning conditions of temperature, pressure, condensation, and time in the containment vessel together with the results of gas sampling, particle sizing, spraying, and deposition testing are given for the experiments. Author (NSA)

N71-25500# Tokyo Univ. of Education (Japan). Dept. of Physics.
COMPTON SCATTERING AT HIGH ENERGIES
Ichiro Shibasaki, Toshiyuki Minamikawa, and Tsunetoshi Watanabe (Asia Univ.) [1971] 39 p refs
(TUEP-71-2) Avail: NTIS

Using the continuous moment sum rule it is found that the third vacuum pole P is important for the forward proton Compton scattering and the residue of the fixed pole at J = 0 is also estimated. The prediction of the high energy total cross section is consistent with recent experimental results. Author

N71-25501# Syracuse Univ., N.Y. Dept. of Physics.
EFFECT OF A TRANSVERSE MOMENTUM DISTRIBUTION IN THE PARTON MODEL
C. W. Gardiner and D. P. Majumdar Apr. 1970 31 p refs Sponsored by AEC
(SU-1206-225; NYO-3399-225) Avail: NTIS

The effect of the transverse momentum distribution is explicitly displayed and discussed for a few momentum distribution functions. The data on inelastic e-p scattering are then analyzed for any significant deviations from scale invariance, and it is concluded that there is evidence for such deviations. Finally an attempt is made to fit the data with the formalism developed. For this purpose use is made of a model for the partons, proposed previously to explain the data in the approximation that scale invariance is satisfied. Some comments are made on the properties of partons which are necessary to fit the data and on the present status of scale invariance breaking. Author (NSA)

N71-25505# Comision Nacional de Energia Atomica, Buenos Aires (Argentina).
RESONANCE INTEGRALS OF NEUTRON ACTIVATION OF Se 74, Se 78, Se 80, Br 81, I 127, Te 130, Ba 138, Ce 140, AND Ce 142
M. D. Ricabarra, R. Turjanski, G. H. Ricabarra, and C. B. Bigham (Atomic Energy of Can., Ltd., Chalk River, Ontario) 1970 26 p refs In SPANISH
(CNEA-274) Avail: AEC Depository Libraries

A lithium-drifted germanium gamma-ray spectrometer was used to make accurate intercomparisons of the ratio of resonance-integral to thermal activation cross section by measuring cadmium ratios or relative activation rates in two different neutron spectra. The standard, gold, or secondary standard, indium, was mixed uniformly in the samples and the activities resolved with the spectrometer. Expressed as Westcott S values, the results relative to S sub 0 = 17.7 for gold were as follows: Se-74: 10.3 + or − 0.1; Se-78: 12.3 + or − 0.3; Se-80: 2.65 + or − 0.02; Br-81: 24.3 + or − 0.5; I-127: 27.8 + or − 0.5; Te-130: 2.10 + or − 0.07; Ba-138: 0.649 + or − 0.004; Ce-140: 0.476 + or − 0.003; and Ce-142: 0.865 + or − 0.005. Author (NSA)

N71-25506 Stanford Univ., Calif.
STUDIES OF HE-4 BY X-RAY SCATTERING
Robert Bruce Hallock (Ph.D. Thesis) 1969 172 p
Avail: Univ. Microfilms Order No. 70-10462

The intensity of copper K sub alpha X-rays scattered from helium four was measured as a function of scattering angle in both the gas phase at 5K and the liquid phase at several lower temperatures. By measuring the intensity scattered from neon these measurements were normalized and the structure factor for helium four in both phases was obtained. The gas phase was shown to be distinctly nonideal. At 0.32K the liquid structure factor agrees with a prediction of Feynman and is linear in momentum transfer up to a value of 0.4/A. Above this value of the momentum transfer, the liquid structure factor exhibits a gentle but definite change of slope and falls below the prediction of Feynman. It is shown that the Bijl-Feynman dispersion relation appears to remain valid up to a momentum transfer of 0.4/A. The measurements indicate that the strong shoulder predicted by Massey is not present. At higher temperatures (up to 2.0K) the zero momentum transfer extrapolation of the structure factor agrees well with the expected behavior deduced from the isothermal compressibility. Dissert. Abstr.

N71-25523# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
STUDY OF (p,d) REACTIONS ON Zr 90 AND Mo 92 WITH POLARIZED PROTONS
J. L. Escudie, J. Gosset, H. Kamitsubo, and B. Mayer 1970 2 p refs Presented at 3d Intern. Symp. on Polarization Phenomena in Nucl. Reactions, Madison, Wis., 31 Aug.–4 Sep. 1970
(CEA-CONF-1654; Conf-700811-7) Avail: NTIS

A study of (p,d) reactions with Zr-90 at 22.9 MeV and Mo-92 at 24.5 MeV is reported. The angular distributions of the cross sections and asymmetries for the first three levels of Zr-89 are similar to those of the corresponding levels in Mo-91. The spin and parity assigned to the first three levels of Mo-91 are 9/2(+) (ground state), 1/2(−) and 3/2(−). The strong j-dependence of the asymmetries for the two excited levels of Zr-89 and Mo-91 is shown. The DWBA satisfactorily explained the measured cross sections and asymmetries. The optical potentials used are listed. The proton potential fits the cross section and polarization for the elastic scattering of protons. The deuteron potential fits the cross section for the elastic scattering of deuterons at 12 MeV. Finite range and nonlocality corrections are included but they do not significantly modify the asymmetry. NSA

N71-25525# Institute of Nuclear Physics, Krakow (Poland).
DECAY DISTRIBUTIONS IN THE REACTION PION(+) PROTON YIELDS KAON(+) Y(1385) RESONANCE AND THE POLARIZATION OF THE LAMBDA HYPERON FROM Y(1385) DECAY AT 8 GeV/c PRIMARY MOMENTUM
D. Kisielewska 1970 9 p refs

(INP-731) Avail: AEC Depository Libraries

The study of the decay distributions of the positive Y*(1385) resonance produced in the reaction pion(+) proton yields kaon resonance Lambda hyperon pion(+) at 8 GeV/c and of the Lambda hyperon polarization from Y*(1385) decay is presented. Statistical tensors both of even and odd rank were calculated and a complete comparison with quark model predictions was done. On the level of the statistics for reaction pion(+) proton yields kaon(+) Y*(1385) available at the moment agreement is observed between the experimental values of the statistical tensors and their quark model predicted values. Author (NSA)

N71-25532# Maryland Univ., College Park. Center for Theoretical Physics.

SOME REMARKS OF THE DIRECT SUM OF (3,3*) AND (3*, 3) BREAKING OF CHIRAL SYMMETRY

Riazuddin and S. Oneda Apr. 1971 9 p refs

(Grants NSF GP-8748; NSF GU-2061)

(TR-71-109) Avail: Issuing Activity

Assuming that SU(3) cross multiplication SU(3) symmetry is of Goldstone–Nambu type and the symmetry breaking Hamiltonian belongs to the (3,3*) direct sum (3*,3) representation of SU(3) cross multiplication SU(3), the eta meson prime yields eta meson pion pion decay is calculated. It turns out that the rate is anomalously small and indicates that the pure (3,3*) direct sum (3*,3) symmetry breaking is unlikely. Author

N71-25540 Rutgers Univ., New Brunswick, N.J.

REORIENTATION EXPERIMENTS IN THE EVEN MASS CADMIUM ISOTOPES: THICK TARGET YIELDS AND GAMMA RAY ANGULAR DISTRIBUTIONS

Stephen Geoffrey Steadman (Ph.D. Thesis) 1969 119 p

Avail: Univ. Microfilms Order No. 70-10106

An attempt was made to observe the reorientation effect in the gamma ray angular distribution of the 2(+) yields 0(+) transition in Cd-114 in coincidence with 36 MeV O-16 ions scattered at 90 degrees in the laboratory system. Calculations were made using both a computer program and using perturbation theory. From the perturbation theory calculation, an anisotropy in the angular distribution is predicted which contains a term that is approximately linear in the reduced matrix element. Both calculations indicate a rotation of the angular distribution by 0.44 degrees. In this case, the expected shift was too small to be observed. A discussion is given of the difficulties encountered in such an experiment. Dissert. Abstr.

N71-25541# Brookhaven National Lab., Upton, N.Y.

GROG I2: A NUCLEAR EVAPORATION COMPUTER CODE. DESCRIPTION AND USER'S MANUAL

Jacob Gilat Jun. 1970 92 p refs

(BNL-50246) Avail: NTIS

GROGI2 is a spin dependent nuclear evaporation program designed to follow in detail the deexcitation of compound nuclei via neutron, proton, alpha, and photon emission channels. These four modes are permitted to compete with one another subject only to the phase space available to each. GROGI2 is written in FORTRAN 4 for the CDC 6600 computer. NSA

N71-25542# Purdue Univ., Lafayette, Ind.

PRODUCTION OF K(+) K(−) AND pion ANTIPION PAIRS IN FOUR BODY REACTIONS AT 13.1 GeV/c

J. A. Gaidos, T. A. Mulera, C. R. Ezell, J. W. Lamsa, and R. B. Willmann [1970] 17 p refs

(Contract AT(11-1)-1428)

(COO-1428-249) Avail: NTIS

Data in the channels pion(+) proton yields pion(+) proton Kaon(+) Kaon(−) and pion(+) proton yields pion(+) proton antiproton proton at 13.1 GeV/c are presented; the Delta 2(+) Kaon(+) Kaon(−) and proton Kaon(+) Kaon resonance (890) subsamples are discussed in terms of a double Regge model. No resonance structure at M(proton antiproton proton) = 3.755 GeV is observed. Author (NSA)

N71-25543 Syracuse Univ., N.Y.

ANTIPROTON NEUTRON ANNIHILATION AT REST INTO FINAL STATES OF 3 AND 4 PIONS

Lee John Gray (Ph.D. Thesis) 1969 109 p

Avail: Univ. Microfilms Order No. 70-10348

The antiprotons were produced by the 30 Bev proton alternating gradient sychrocyclotron. The antiprotons then were separated from undesired particles and brought to rest in a 30 inch hydrogen bubble chamber filled with deuterium. The analysis of the 3 and 4 pronged events with a proton yielded examples of the reactions antiproton deutrons yield 2 pion(−) pion(+) and antiproton deutron yield 2 pion(−) pion(+) pion proton. The branching ratios for these final states with respect to all antiproton-neutron annihilations at rest were found to be .023 + or − 003 and .137 + or − .02 respectively. The 2 pion(−) pion(+) Dalitz plot is highly anistropic and no satisfactory solution was found. The branching ratios with respect to the 2 pion(−) pion(+) pion(0) proton final state were determined. In addition, the reaction antiproton deutron yields pion(−) neutral omega meson proton was identified with a branching ratio, and the neutral omega meson quantum numbers were confirmed. Dissert. Abstr.

N71-25544 Texas A&M Univ., College Station.

TOPICS IN SCATTERING THEORY

Gary Don McCartor (Ph.D. Thesis) 1969 96 p

Avail: Univ. Microfilms Order No. 70-11559

It is shown, in a certain rather general sense of convergence, and with appropriate restrictions on the potential and expansion functions, that the Kohn variational principle converges to the correct answer in the case of two particle S wave scattering. The two particle Bethe–Salpeter equation is studied and a contour is given which makes the kernel for the equation describing the scattering of two baryons in the ladder approximation non-singular in the energy range between the first and second inelastic thresholds. Dissert. Abstr.

N71-25545# Australian National Univ., Canberra. Inst. of Advanced Studies.

TENSOR POLARIZATION OF DEUTERONS FROM THE Mg (d,d) Mg ELASTIC SCATTERING AT 7.0 MeV

A. Djaloeis and J. Nurzynski [1970] 22 p refs

(ANU-P/498) Avail: NTIS

The spin tensor moments of deuterons emitted from the Mg(d,d)Mg elastic scattering reaction were measured. The average deuteron energy at the centre of the effective target thickness was 7.0 MeV. The angular dependence of the deuteron tensor polarization was obtained for angles between 15 deg and 90 deg (lab) in steps of 7.5 deg. Optical model analyses without and with the inclusion of the Hauser–Feshbach theory were performed. In all cases, combinations of central potential with spin-orbit interaction were found inadequate to reproduce the data. The addition of a small attractive and long ranged tensor interaction resulted in a considerably improved fit. Inclusion of a T sub L tensor interaction was redundant. Author

N71-25552 Washington Univ., St. Louis, Mo.

PHONON CHARGE CARRIER INTERACTIONS IN SEMICONDUCTORS AND METALS: CONTINUOUS WAVE ULTRASONIC MEASUREMENTS AND TECHNIQUES

James Gegan Miller (Ph.D. Thesis) 1969 165 p

Avail: Univ. Microfilms Order No. 70-10983

Some ultrasonic measurement techniques, based on a theory of ultrasonic resonator responses, are developed and applied to the study of phonon-charge carrier interactions in aluminum and in 3 and 5 semiconductor compounds. A general expression for the response of a one dimensional ultrasonic resonator, which includes the familiar pulse echo and continuous wave (cw) responses as limiting forms, is obtained. The role of the ultrasonic resonator in the enhancement of signals corresponding to small changes in ultrasonic velocity and attenuation is indicated. Sensitivity enhancements for the pulse-echo, sampled continuous wave, and continuous wave modes of operation are calculated and quantitatively compared. A series of experimental verifications of the theory is presented. A reflection bridge spectrometer is applied to verifying the predicted cw frequency domain line shapes of the in- and out-of-phase components of a resonator response. Dissert. Abstr.

N71-25553# Kyoto Univ., Japan. Research Inst. for Fundamental Physics.

A CONDITION FOR REGGE ASYMPTOTIC BEHAVIOURS

Masanori Kobayashi Mar. 1971 8 p refs

(RIFP-118) Avail: NTIS

A condition is given for the infinite one particle-exchange type model imposed from the requirement of Regge asymptotic behaviour. Author

N71-25554# Australian National Univ., Canberra. Inst. of Advanced Study.

THE DECAY OF Ti 45 TO Sc 45

W. M. Zuk, W. F. Davidson, M. R. Najam, and M. A. Awal [1971] 10 p refs

(ANU-P/509) Avail: NTIS

The low intensity beta(+)/E.C. branches in the decay of Ti-45 to excited states of Sc-45 were re-investigated in order to resolve discrepancies in reported branching ratios. A new branch to the 974 keV level, having an intensity of 9.9 + or − 1.2 × 10 to the minus 5th power/decay was found. A previously reported branch to the 1237 keV level was found to be in error. The intensities for decay to the levels at 720, 1408 and 1681 keV levels were determined to be 154 + or − 12, 90.2 + or − 9.7 and 52.5 + or − 5.6, respectively, in units of 10 to the minus 5th power per decay. Author

N71-25555* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

PROCESS FOR REDUCING SECONDARY ELECTRON EMISSION Patent

Hubert Erpenbach, inventor (to NASA) Issued 17 Nov. 1970 (Filed 8 Jun. 1967) 4 p Cl. 204-168; Int. Cl. H01j43/02 Sponsored by NASA

(NASA-Case-XNP-09469; US-Patent-3,540,989; US-Patent-Appl-SN-645573) Avail: US Patent Office CSCL 20H

A method of depositing a hard coat of carbon on the surface of a metalic element is discussed. The method consists of placing the element in a chamber, evacuating the chamber and applying a potential between the element and an anode, the element being at the lower potential. Then an inert ionizable gas is injected into the chamber at a controlled rate and pressure. It produces surface glowing which cleans the metallic surface. Thereafter, the supply of the inert gas is terminated, and while the potential is applied, a carbon containing gas is injected into the chamber. The gas ionizes, with carbon ions being attracted by the element to form a hard carbon film. Official Gazette of the U.S. Patent Office

N71-25556 Lehigh Univ., Bethlehem, Pa.

ON 14307 TAU PLUS DECAYS ANALYZED TO OBSERVE POSSIBLE DELTA T = 1/2 VIOLATION, AND CP NONCONSERVATION

Vasant V. Mainkar (Ph.D. Thesis) 1969 80 p

Avail: Univ. Microfilms Order No. 70-10610

Tau decays of the K meson were observed in photographs made of a 30 inch propane bubble chamber. The magnetic field at the center of the chamber was about 14 kG. Track coordinates in three different views of the chamber were digitized and the tracks reconstructed in space by a computer program. The momentum of each track was obtained from its range. The energy distribution of the final state pions in the selected events was compared to the existing theoretical models. Pion energy spectra are given in terms of Dalitz variables and fits were made to a matrix element expressed as a power series of the Dalitz coordinates X and Y. Another fit was made to two resonance models which treat the resonant interaction between outgoing pions. Separate dependence of the decay matrix element on each X,Y was first examined and the dependence was found to be linear on Y and none on X. Then investigation was made into the combined dependence on X and Y and a significant non-linear contribution was observed. Dissert. Abstr.

N71-25558 Massachusetts Univ., Amherst.

NUCLEAR STRUCTURE STUDIES THROUGH DIRECTIONAL CORRELATIONS

Nand Kishore Gupta (Ph.D. Thesis) 1970 151 p

Avail: Univ. Microfilms Order No. 70-10034

In the decay of Tl-208, beta-gamma correlations involving the 1.795 MeV, 1.520 MeV and 1.286 MeV beta-groups with appropriate cascade gamma-rays were measured. These correlations have been found to be small, consistent with the xi-approximation. These results in conjunction with the known structure of the ground state of Tl-208 are discussed in terms of particle-hole structure of low lying excited states of Pb-208. In the decay of Sb-126, beta-gamma correlation involving the 1.9 MeV beta group with 415 KeV gamma-ray clearly rules out an 8(−) assignment for the ground state of Sb-126. In the decay of Bi-214, beta-gamma correlations involving the 1.8 MeV beta group with the 769 KeV stop-over gamma ray and also with the 1378 KeV cross-over gamma ray were measured. Assignment of 1(−) for the spin and parity of the ground state of Bi-214 is most consistent with our measurements and the shape of the ground state beta transition. Preliminary results of the beta-gamma correlation in the second forbidden beta decay of Nb-94 using two sources of thickness 4 mg/sq cm and 8 mg/sq cm respectively, are presented. Dissert. Abstr.

N71-25565# Atomic Energy Commission, Aiken, S.C. Savannah River Operations Office.

GUIDE FOR FABRICATING AND HANDLING Cf 252 SOURCES

Jan. 1971 67 p refs

(SRO-153) Avail: NTIS

A review is presented of the radiation and decay properties of californium-252, health physics procedures for working with Cf-252, routine handling techniques for sealed sources and for unencapsulated Cf-252 shielding requirements, containment and ventilation requirements, packaging and labeling requirements for shipping containers, purification techniques, Cf-252 product description, and the techniques and facilities at Oak Ridge National Laboratory and Savannah River Labroatory for fabricating and testing encapsulated sources. Author (NSA)

N71-25566# California Univ., Davis. Crocker Nuclear Lab.

STATUS OF NUCLEON-NUCLEON BREMSSTRAHLUNG

F. P. Brady Dec. 1970 30 p refs Presented at the Am. Phys. Soc. Meeting, Stanford, Calif., 28 – 30 Dec. 1970

(Contract AT(11-1)-GEN-10)

(UCD-CNL-EX-130) Avail: NTIS

The review of nucleon-nucleon bremsstrahlung covers the

experimental techniques and a comparison of experiment and theory. It is concluded that off-shell effects are seen in pion pion gamma and neutron pion gamma, and discrepancies in the off-shell behavior of N-N interaction models are detected in pion pion gamma. NSA

N71-25570 Cornell Univ., Ithaca, N.Y.
ON THE GROUND STATE OF LIQUID HELIUM FOUR
William Porter Francis (Ph.D. Thesis) 1969 135 p
Avail: Univ. Microfilms Order No. 70-5767

A trial wave function describing the ground state of a quantum system of N interacting bosons is written in the Jastrow form, a product of pair functions. With the interaction potential chosen to represent liquid helium four, and with the parameterized form of the pair function chosen to include a long range term which was found necessary for the representation of the phonon modes known to exist in liquid helium, a minimum energy variational calculation was performed. The essential results are that including the phonon modes in the wave function definitely lowers the energy, corrects the behavior of the structure function and the momentum distribution of the particles in the low wave number region, and decreases the Bose – Einstein condensate fraction. The value of the lower limit on the wavelength of the phonon modes was determined variationally to be about three interparticle spacings. Dissert. Abstr.

N71-25573 Kansas Univ., Lawrence.
NUCLEAR FORCES IN O-S SHELL NUCLEI
Mark Charles Bruels (Ph.D. Thesis) 1969 105 p
Avail: Univ. Microfilms Order No. 70-11004

The Bolsterli – Feenberg perturbation technique is applied to the recent potentials of Nestor, Davies, Krieger, and Baranger. Binding Energies, RMS radii, and percentage D states are calculated for the o-s shell nuclei H-2, H-3, and H-4. The Coulomb energies of He-3 and He-4 are also calculated. The Goldhammer potential is used to check programming accuracy. A novel approach to the separation method for solving the Bethe – Goldstone equation with reference spectrum techniques is presented. The separation method is found to be much less accurate than the Bolsterli – Feenberg perturbation method due to the explicit momentum dependence of the Baranger potentials. Agreement of the Baranger potentials with experiment is satisfactory. Dissert. Abstr.

N71-25574 Stanford Univ., Calif.
INVERSE PHOTONUCLEAR REACTORS IN THE UPPER PART OF THE 1p SHELL
William John O'Connell (Ph.D. Thesis) 1969 121 p
Avail: Univ. Microfilms Order No. 70-10498

The yield and angular distributions of the reaction N15(proton, gamma sub 0)O16 were measured from E sub x = 20 to 29 MeV. In this region the total yield is falling slowly with energy and the angular distributions vary smoothly. Between E sub x = 20 and 25 MeV the yield and angular distributions were measured more accurately than in earlier work. It is found that the observed structures can be attributed to interference between the following 1(–) resonances: the principal giant resonance states at E sub x = 22.16 and 26 MeV and three narrower states (300 - 500 keV wide) correlated in energy and width with 1(–) states in O16 seen in heavy particle capture reactions at E sub x = 21.06, 22.78, and 24.07 MeV. The reactions N15(proton, gamma sub 1 yields gamma 4)O16 and N15(proton, alpha gamma 15.11)C12 were studied in order to observe other T = 1 resonances in O16. The giant dipole resonances in O15 and N14 were studied through the reactions N14(proton, gamma)O15 and C13(proton, gamma)N14. The C13(proton, gamma sub 1)N*14 (O –, T = 1) yield was also observed. Dissert. Abstr.

N71-25579# California Univ., Livermore. Lawrence Radiation Lab.
CONTROLLED THERMONUCLEAR RESEARCH Annual Report, Jul. 1969 – Jun. 1970
21 Jul. 1970 208 p refs
(UCRL-50002-70) Avail: NTIS

Research on the astron thermonuclear reactor program was continued. Efforts were expanded on computer simulation in plasma regimes related to the major experiments. Studies of ion-cyclotron loss-cone modes primarily to check related nonlinear theories were made. In mirror theory, studies of the effects of inhomogeneities along the magnetic field on loss-cone modes have led to stability bounds at high density and moderate mirror ratios. Theoretical survey of the E-layer has confirmed that the excitation of the hybrid plasma oscillation can be quenched by several damping processes. Further, it is shown that a plasma equilibrium with favorable average particle drifts everywhere can be produced. Also, mechanical and electrical engineering development related to these programs are reported. E.M.C

N71-25580 New Mexico Univ., Albuquerque.
AN INVESTIGATION OF CRITICALITY FOR ENERGY DEPENDENT TRANSPORT IN SLAB GEOMETRY
Paul Nelson, Jr. (Ph.D. Thesis) 1969 173 p
Avail: Univ. Microfilms Order No. 70-10126

The abstraction is intended to encompass both the classical neutron transport problem and some discrete approximations in this problem. The classical problem has the mathematical form phi = gamma K phi + q. Here phi is the angular flux of neutrons, K is the (linear) integral transport operator, gamma is an eigenparameter, and q is the known source contribution to the flux. Physically gamma is the maximum expected number of neutrons resulting from a collision. The operator K is defined so that K phi (z,v) is the contribution to the angular flux at the point z and velocity v from neutron collisions at all points and velocities. The abstraction consists in replacing the velocity vector v by a state vector ranging over a measure space which satisfies certain natural requirements. Although a general physical interpretation is not found, it is shown that the function describing the importance of a collision for a barely critical slab is an eigenfunction of K* which is an adjoint operator. Dissert. Abstr.

N71-25581 Syracuse Univ., N.Y.
DONOR-ACCEPTOR RADIATIVE ELECTRON TRANSFER SPECTRA IN SILICON AS A FUNCTION OF CONCENTRATION AND TEMPERATURE
James Gust Constantine (Ph.D. Thesis) 1969 170 p
Avail: Univ. Microfilms Order No. 70-10332

Radiative intensities, linewidths, and frequency shifts associated with the donor-acceptor electron transitions were studied for various combinations of shallow donors and shallow acceptors. The spectra for most combinations of shallow impurities at 4.2K generally consisted of a no-phonon (NP) line and (TA), (TO), (TA+TO), and (2TO) phonon-assisted lines. Several line broadening mechanisms are elucidated in these investigations and they are separated out by their different behavior and dominance in distinct temperature regions. The mechanisms considered involved (1) Coulomb broadening due to the extended range of separations of donor-acceptor pairs. (2) Intrinsic broadening through the electron-phonon interaction according to the theory of Lax. (3) Motional narrowing of the coulomb linewidth due to electron and hole resonant hopping between neutral and ionized impurities of the same type. (4) Additional radiative recombinations from the donor low lying excited states, and (5) Exchange interaction between close donor pairs. Dissert. Abstr.

N71-25582 Rensselaer Polytechnic Inst., Troy, N.Y.
TRINUCLEON CALCULATIONS WITH RANK TWO

SEPARABLE POTENTIALS
Thomas Joseph Brady (Ph.D. Thesis) 1969 181 p
Avail: Univ. Microfilms Order No. 70-11313

The three body Faddeev equations for the tri-nucleon binding energy, BE sub 3, and doublet scattering length, a(2), for a number of rank two separable potentials are solved. These potentials, some of which are due to Mongan, contain both attraction and repulsion and fit the phase parameters with varying degrees of accuracy. The phase shifts given by the Mongan potentials are in good agreement with experiment; however the percentage of D state, P sub D, in the deuteron wave function, given by these potentials is quite small. These potentials which use forms first proposed by Tabakin, give higher P sub D (2%,4%) but poorer fits to the phase shifts. The results span a range of BE sub 3 = 8.76 MeV, a(2) = 0.416 f to BE sub 3 = 10.16 MeV, a(2) = 0.377 f, these extremes being obtained with the Mongan potentials. Calculations indicate that the inclusion of repulsion in the singlet state lowers BE sub 3 by 0.5 to 1.5 MeV depending on the potential used, while repulsion in the triplet state subtracts a few tenths of an MeV from the binding energy. Dissert. Abstr.

N71-25583# California Univ., Livermore. Lawrence Radiation Lab.
HAZARDS CONTROL Progress Report, May – Aug. 1970
Aug. 1970 29 p refs
(UCRL-50007-70-2; PR-37) Avail: NTIS

The status of research programs on radiation protection is briefly summarized. Activities reported include: the development of a method for measuring the atmospheric diffusion of tritium, or other radioactive material, at various locations downwind from the source following release in stack gas; an evaluation of the efficiency of stack gas and atmosphere tritium monitors; the use of a Monte Carlo Neutron Transport Code (SORS) to calculate the moderated fast neutron spectra of Cf-252 in spheres of D2O and reactor-grade graphite; calculations of the dose rate of Cf-252 in D2O spheres; and the use of a desk-type computer to calculate the Co-60 gamma dose distribution from an array of source pencils suspended in water in a cylinder. NSA

N71-25584 Virginia Polytechnic Inst., Blacksburg.
SINGLE PROTON EMISSION FOLLOWING POSITIVE PION CAPTURE IN CARBON
Thomas Riner Witten (Ph.D. Thesis) 1970 41 p
Avail: Univ. Microfilms Order No. 70-9918

A search for the reaction C-12(pion(+),proton)C-11 at 73 MeV pion energy and 0 deg proton emission angle is reported. This reaction is somewhat rare because the initial neutron absorbing the pion must have a momentum of 460 MeV/c, which is quite large. The observed cross section is about 430 + or − 110 b/sr for absorption by a 1p 3/2 neutron, although the precise number is a little uncertain. This number is compared to two theoretical values. Also, the highest energy protons from the reaction C-12(pion(+), proton proton)B-10 were observed and fitted to a phase space calculation. Dissert. Abstr.

N71-25585 Rensselaer Polytechnic Inst., Troy, N.Y.
ISOMER RATIOS FOLLOWING MULTIPLE PARTICLE EMISSION
George Scott Liggett (Ph.D. Thesis) 1969 208 p
Avail: Univ. Microfilms Order No. 70-11325

Isomer ratios following multiple particle nuclear emissions were theoretically calculated. These calculations were performed using the compound nuclear statistical model. The theoretically determined values of the isomer ratios were compared to experimentally determined values. This comparison was performed to study the variation of the nuclear density of levels with spin, and to study the amount of quadrupole radiation in the gamma ray cascade. These calculations were performed using a method for studying the deexcitation of a nucleus. The form of the density of levels was calculated by treating the nucleus as a free Fermi gas. The particle transition rates between the levels were obtained from the absorption cross section by using the reciprocity theorem. The absorption cross sections were calculated using the optical model. The Weisskopf estimates were used for the gamma ray transition rates. Dissert. Abstr.

N71-25586 Rensselaer Polytechnic Inst., Troy, N.Y.
SEPARABLE EXPANSIONS OF THE TWO-BODY T-MATRIX AND THE THREE-BODY PROBLEM
Edward Albert Harms 1969 204 p
Avail: Univ. Microfilms Order No. 70-11319

The theory of a one term separable approximation called the unitary pole approximation (UPA) is developed in a manner suitable for bound or antibound states. Methods for handling the antibound state are discussed and a few examples are given. A new separable expansion of the two-body potential is derived. The expansion, called the unitary pole expansion (UPE), has as its first term the UPA, satisfies unitarity in all orders, and gives the correct bound state pole for the two-body T-matrix. The convergence of the UPE is examined by comparing the T-matrices arising from different orders in the expansion with actual T-matrices obtained by solving the Lippmann – Schwinger equation. The expansion is investigated further by performing three-body bound state calculations. The convergence of the UPE is more rapid than other series expansions and is especially good for potentials with repulsion. In this case one term gives a binding energy accurate to within 0.1 MeV. Results indicate that for the type of problem investigated separable potentials are valid for studying three-nucleon systems. Dissert. Abstr.

N71-25587 Lehigh Univ., Bethlehem, Pa.
ON PLASMON EFFECTS IN TRANSITION RADIATION
Thomas Kenneth Bolland (Ph.D. Thesis) 1969 119 p
Avail: Univ. Microfilms Order No. 70-10585

The theory of the radiation emitted when a charged particle crosses a boundary between two different media is developed. The method used is the direct calculation of the fields without the introduction of potentials, by the Fourier transform technique. The boundary conditions of Maxwell's theory must be met at the interface between the media. The radiation depends on the nature of the media. The media considered are vacuum and metal, where the metal is assumed to be described by the free-electron-gas model. Consideration of the plasma waves leads to corrections to the previously derived formulas for transition radiation. Graphs are given showing the relative changes as functions of particle energy, film thickness, observation direction and frequency; tables are presented giving the intensity of the radiation per unit solid angle per unit frequency interval and comparing to the previous results. In particular, it is found that there is fine structure in the radiation at frequencies above the plasma frequency for very thin foils. Dissert. Abstr.

N71-25588 Rutgers Univ., New Brunswick, N.J.
THREE ALPHA MODEL OF C 12
Stephen F. Becker (Ph.D. Thesis) 1969 84 p
Avail: Univ. Microfilms Order No. 70-10045

A model for C-12 is considered in which the nucleus is treated as being composed of three rigid alpha-particles. The O(+) bound states of the system are studied using the Faddeev equations. As input into these equations, a separable alpha-alpha interaction is used to simulate the strong part of the alpha-alpha effective potential. A method is also discussed in which the input into the Faddeev equations is still separable but contains a large part of the Coulomb effects. In addition to the S-wave term, a D-wave term has been included in the alpha-alpha interaction. This term is found to give a negligible contribution to the three-alpha binding energies. A repulsive term in the S-wave has also been

included. Solving the Faddeev equations without repulsion in the alpha-alpha interaction, a ground state (− 12.8 MeV) and one excited state (− 3.1 MeV) are found. Dissert. Abstr.

N71-25589 Florida State Univ., Tallahassee.
AN ANALYSIS OF THE REACTION PION(+) PROTON YIELDS PION(+) PROTON PION(+) PION(−) AT 11.0 GeV/c
Benjamin Carleton Harms (Ph.D. Thesis) 1969 208 p
Avail: Univ. Microfilms Order No. 70-11122

The reaction, positive pion proton yields positive pion proton positive pion negative pion, which is found to be dominated by neutral rho pion and delta hyperon (++) (1236) is analyzed. The events are analyzed by making a cut on the Peyrou distribution of the proton's laboratory momentum. The neutral rho pion is found to be created in very peripheral collisions, while the delta hyperon (++) (1236) is found in the less peripheral events. The delta squared sub (proton yields proton) distribution appears to have a periodic structure. The structure occurs for those events in the peripheral region and is completely absent in the events outside this region. The structure is well fit by an inelastic strong absorption model, but the model requires the proton to have a radius of 7 fm. Some evidence is presented to corroborate this value. A technique for removing unwanted background is discussed. The technique is used to select events which proceed via one-pion-exchange and plots obtained from these events are compared to the predictions of the one-pion-exchange model. Dissert. Abstr.

N71-25590# Tufts Univ., Medford, Mass. Dept. of Chemistry.
DEUTERON MAGNETIC RESONANCE Progress Report
B. M. Fung 1 Feb. 1971 3 p
(Contract AT(30-1)-3965)
(NYO-3965-3) Avail: NTIS

The preparations of (C5H5)2WD2, (C5H5)2MoD2, and (CH3)2N=BD2 are described, and the deuterium quadrupole coupling constants were determined. The oxygen electric field gradient in H3O(+) was calculated. N.E.N.

N71-25591# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
MEASUREMENT OF THE TOTAL CROSS SECTIONS OF THE PION(−) PROTON INTERACTION IN THE ENERGY RANGE FROM 4.0 TO 6.0 GeV WITH THE SYSTEMATIC ERROR NOT MORE THAN 30 MICROBARN
N. Giordenesky, V. N. Zubarev, V. I. Ivanov, N. S. Moroz, V. B. Radomanov et al 1970 14 p refs In RUSSIAN
(JINR-P1-5460) Avail: AEC Depository Libraries

Using the Cerenkov hodoscope the total cross sections of the pion(minus) proton interactions in the energy region from 4.0 to 6.0 GeV were measured with the systematic error no more than 30 microbarn. Author (NSA)

N71-25592 Cornell Univ., Ithaca, N.Y.
A CALCULATION OF THE TWO BODY ELASTIC SCATTERING AMPLITUDE FOR AN ISING MODEL QUANTUM FIELD THEORY ON A LATTICE SPACE
Ashok Suri (Ph.D. Thesis) 1969 215 p
Avail: Univ. Microfilms Order No. 70-11252

The Ising model of Ferromagnetic Phase transition (IPT) slightly above the critical point as a local Hamiltonian quantum field theory is interpreted on a lattice space and continuous time. The Hamiltonian H of this Ising model Quantum Field theory (IQFT) is obtained from the transfer matrix V of the IPT. With this Hamiltonian the two theories (IQFT and IPT) are isomorphic and the n-point functions of the IQFT are a suitable analytic continuation, to pure imaginary time, of the n spin correlation functions of the IPT. The compton wave length in IQFT corresponds to the correlation length in IPT and the lattice spacing (a) given the high momentum cutoff. Because of this isomorphism we can borrow the high temperature expansion techniques of statistical mechanics to calculate the eigenstates of the IQFT. In particular this allows us to set up the calculation of the two particle eigenstates in the form of a Lippmann−Schwinger equation, which is solved by techniques of quantum field theory. Dissert. Abstr

N71-25593# California Univ., Livermore. Lawrence Radiation Lab.
ASSESSMENT OF NEUTRAL INJECTION FOR THE SUPERCONDUCTING LEVITRON
C. W. Hartman and E. B. Hooper, Jr. 19 Nov. 1970 14 p refs
(UCRL-50976) Avail: NTIS

Analysis of the plasma obtainable by neutral injection into the superconducting levitron is presented. Existing sources (multi-apertured test sources) can yield hydrogen plasmas with n approximately 10 to the 13th power/cu cm and T sub e ~ T sub i > 0.3 keV; presently contemplated sources would yield n ~ 10 to the 14th power/cu cm and T sub e ~ T sub i > or ~ to 1 keV. The limitations imposed by cold background gas are considered, and engineering problems are discussed briefly. Author (NSA)

N71-25599 Michigan State Univ., East Lansing.
ELECTRIC FIELD INDUCED SPECTRA OF LINEAR AND AXIALLY SYMMETRIC MOLECULES
Peter Lee Willson (Ph.D. Thesis) 1969 108 p
Avail: Univ. Microfilms Order No. 70-9862

Selection rules and line strengths were calculated for electric field induced spectra (EFS) of axially symmetric and linear molecules. A suitable optical arrangement and appropriate experimental techniques have been developed. Experimental observations of EFS of the linear molecules HCN and DCN and of the axially symmetric molecules CH3I, CH3Br, CH3Cl, CH3F, and CH3CN were carried out and found to exhibit many of the predicted features. Dissert. Abstr.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N71-24366# Atomic Energy Commission, Washington, D.C. Div. of Technical Information.
ROLE OF REPEATED IGNITION OF DISCHARGES IN ZETA-PINCH DYNAMICS
I. F. Kvartskhava et al Sep. 1970 12 p refs Transl. into ENGLISH of Gos. Kom. po Ispolz. At. Energ. SSSR, Fiziko-Tekhn. Inst., Sukhumi, USSR, report NP-18065
(AEC-tr-7170; NP-18065) Avail: NTIS

Previous experimental studies of linear Z pinches revealed clearly expressed current-voltage curve breakages, which were named the peculiarities. Analyses of the current and voltage oscillograms and results of experiments indicated a direct relationship between the observed peculiarities and repeated charge ignition along the walls of the discharge chamber appearing as a result of the induction. The obtained high speed streak photographs, distribution curves of the current density along the chamber radius (corresponding to the repeating breakdown time), and the oscillogram of the signal from the magnetic probe placed inside the plasma shell also confirmed the above conclusion. The repeated discharge ignition, appearing in the early stages, limited significantly the rate of incoming energy in the pinch and interfered with plasma heating. Author (NSA)

N71-24367# ARO, Inc., Arnold Air Force Station, Tenn.
INSTABILITIES IN MHD ACCELERATORS Final Report, Jul.

1967 – Jul. 1988
G. W. Garrison AEDC Feb. 1971 67 p refs
(Contract F40600-71-C-0002)
(AD-718954; AEDC-TR-70-290) Avail: NTIS CSCL 20/9

A linearized perturbation analysis is used to determine if instabilities can occur in MHD accelerators. When the electrical perturbations are assumed unaffected by the presence of conducting walls, the enthalpy wave has the largest growth rate. The growth rate depends upon the orientation of the current vector to the wave front and the location within the accelerator. When the electrical perturbations are influenced by the presence of the slanted conducting walls, the upstream-moving magneto-acoustic wave is amplified. When steady-state gradients are neglected, the growth rate changes only slightly in both cases. An elevated electron temperature increases the enthalpy wave growth rate in the absence of conducting walls, but has little effect when the conducting walls control the electrical perturbations. The linearized analysis indicates that instabilities can exist in MHD accelerators and the growth rate may be large in some cases. Author (GRA)

N71-24494# European Space Research Inst., Frascati (Italy).
ANISOTROPY INSTABILITIES OF HYDROMAGNETIC WAVES
Marino Dobrowolny and Andre Rogister [1971] 6 p refs Submitted for publication
Avail: NTIS

A derivation and discussion is given of the dispersion relation for hydromagnetic waves in a finite beta anisotropic plasma, at frequencies above ion cyclotron frequency, wavelengths smaller than ion Larmor radius and propagating almost perpendicularly to the background magnetic field. Author (ESRO)

N71-24495# European Space Research Inst., Frascati (Italy).
NONLINEAR THEORY OF HYDROMAGNETIC WAVES IN A HIGH BETA PLASMA
Marino Dobrowolny and Andre Rogister [1971] 26 p refs Submitted for publication
Avail: NTIS

A nonlinear integro differential equation is derived governing the space time evolution of nonlinear hydromagnetic waves in a finite beta collisionless plasma. The theory is done for quasiperpendicular propagation, for wave frequencies above ion cyclotron frequency and wavelengths smaller than ion Larmor radius. In the low beta limit, the derived equation reduces to a Korteweg de Vries equation. Author (ESRO)

N71-24583# Colorado State Univ., Fort Collins. Dept. of Electrical Engineering.
MICROWAVE REENTRY PLASMA DIAGNOSTICS
James P. Rybak Jan. 1971 103 p refs
(Contract F19628-70-C-0035; Proj. Themis)
(AD-718981; AFCRL-71-0012; SR-3) Avail: NTIS CSCL 20/9

An analysis of surface-mounted aperture antenna admittance has been performed in this study to determine the conditions under which admittance measurements can be used for reentry plasma diagnostics. The primary contribution of the present work is the determination that the admittance of a thin, microwave aperture antenna, located on the surface of a reentry vehicle, can be used to obtain the values of the electron density, electron collison frequency, ion sheath thickness and electron temperature of the reentry plasma. It is further demonstrated, by using admittance measurements made during a reentry test flight as reported by Mayhan et al., that open-ended-waveguide antenna admittances can be used to determine the plasma electron density, electron collison frequency and plasma stand-off distance when the reentry plasma is separated, due to aerodynamic boundary layer effects, from the surface of the reentry vehicle. Author (GRA)

N71-24838# Naval Postgraduate School, Monterey, Calif.
REPORT ON THE 4TH EUROPEAN CONFERENCE ON CONTROLLED FUSION AND PLASMA PHYSICS
F. Schwirzke 26 Jan. 1971 30 p refs Conf. held at Rome, 31 Aug. – 4 Sep. 1970
(AD-719427; NPS-61; SW71011-A) Avail: NTIS CSCL 20/9

The titles of the 17 sessions and the 6 invited lectures are summarized. Concerning the content of the 191 presented papers, only the ones referring to toroidal confinement, laser produced plasmas, collisionless shocks and turbulent heating are reviewed in this report, as for example: papers presented by the Russian participants on particle confinement, energy balance, ion and electron thermal conduction, anomalous resistivity, current diffusion and skin depth in tokamaks. The second part of the report contains the paper No. 114, Investigation of Laser Produced Plasmas in a Magnetic Field. Author (GRA)

N71-24888*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AREA INFLUENCES AND FLOATING POTENTIALS IN LANGMUIR PROBE MEASUREMENTS
Edward P. Szuszczewicz Apr. 1971 38 p refs Submitted for publication
(NASA-TM-X-65516; X-625-71-149) Avail: NTIS CSCL 20I

An analysis was conducted in the influence of a relatively small reference electrode in a Langmuir probe measurement of plasma density and temperature. It is shown that a ratio alpha of reference-electrode area to probe area of 10,000 will guarantee no distortion of the measurement as a result of a shifting reference-electrode potential. It is further shown that the constraint on alpha can be relaxed by approximately two orders of magnitude when the ion mass is decreased from 200 to 1 amu and the ratio of reference-electrode radius to Debye length is decreased from 100 to 0. An additional result of the analysis is the dependence of a probe's floating potential on its geometry and radius as well as on the properties of the plasma. Author

N71-24894# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
EURATOM-CEA ASSOCIATION PLASMA PHYSICS AND CONTROLLED FUSION DEPARTMENT Research Group Progress Report, 1 Apr. 1969 – 28 Feb. 1970 [ASSOCIATION EURATOM-CEA DEPARTMENT DE PHYSIQUE DU PLASMA ET DE LA FUSION CONTROLLEE RAPPORT D'ACTIVITE DU GROUPE DE RECHERCHES POUR LA PERIODE 1ER AVRIL 1969 – 28 FEVRIER 1970]
1970 121 p refs In FRENCH
(EUR-CEA-FC-542(PT.1)) Avail: AEC Depository Libraries

The scientific results obtained by the services and sections in 1969 are presented. The ionized gas theory section presents a brief account of published and current work. The plasma physics section gives an account of the work undertaken: interaction mechanisms between radiation andmatter, nonlinearities associated with the propagation of waves in plasmas, and microinstabilities and spectroscopy. The activities of the plasma confinement group are presented in three chapters: (1) confinement in an open configuration, (2) confinement in a closed configuration, and (3) formation and heating of the plasma. Author (NSA)

N71-24958# P. E. C. Research Associates, Inc., Louisville, Colo.
QUANTUM MECHANICAL STUDY OF PLASMAS. PART 2: APPLICATION OF FLOQUET THEORY TO THE CALCULATION OF RESONANCE FREQUENCIES AND DISPERSION RELATIONS Final Report
Neil Ashby and John Ross Wright-Patterson AFB, Ohio AFL Nov. 1970 190 p refs
(Contract F33615-69-C-1554)

(AD-719799; ARL-70-0274-Pt-2) Avail: NTIS CSCL 20/9

An improved statistical model for electrons in atoms is developed based on an expansion of the one-electron Greens function in spherical harmonics. Improved results in the total energies and electron densities near the nucleus, as compared with the Thomas-Fermi model, are obtained. The model is generalized to include relativistic effects. An improved treatment including retardation effects of surface plasmon dispersion relations, and of the transmission and reflection coefficients for light incident on a semi-infinite plasma, is given. An exact method for solution of a system of coupled differential equations with periodic coefficients is discussed and applied to electromagnetic wave propagation through a gas of spins, and to the Bloch equations for a magnetic moment in an oscillating magnetic field. Author (GRA)

N71-24970# Army Foreign Science and Technology Center, Washington, D.C.

PLASMA DIAGNOSTICS [DIAGNOSTIKA PLAZMY]

6 Nov. 1970 22 p refs Transl. into ENGLISH of the book "Atomizdat, Issue 2" Moscow, 1968 17 p

(AD-719576; FSTC-HT-23-883-70) Avail: NTIS CSCL 20/9

The collection of articles involved deals with the development, analysis and applications of experimental methods for investigating plasma. The article translated deals with problems in the construction and application of Michaelson interferometers with large interference fields in plasma physics analyses. GRA

N71-24976# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d-Etudes Nucleaires.

PARTICULAR MHD SOLUTIONS [SOLUTIONS PARTICULIERES DE LA MHD]

J. Pantuso Sudano Nov. 1970 10 p refs In FRENCH

(EUR-CEA-FC-571) Avail: AEC Depository Libraries

A particular solution of the linearized MHD system inside a neutral sheet is given. The perturbation of the vector potential is described by a partial differential equation with variable coefficients. This equation is transformed into a wave equation by a transformation of the space variable. Author (NSA)

N71-24978# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

PRODUCTION OF INTENSE BEAMS OF FAST NEUTRAL PARTICLES USING PLASMA ACCELERATORS OF THE PLEIADE TYPE [CONSIDERATIONS SUR LA PRODUCTION DE FAISCEAUX INTENSES DE NEUTRES RAPIDES A L'AIDE D'ACCELERATEURS DE PLASMA DU TYPE PLEIADE]

R. Geller, B. Jacquot, and C. Jacquot Oct. 1970 33 p refs Sponsored in part by Euratom

(EUR-CEA-FC-567) Avail: AEC Depository Libraries

The performance of Pleaide-type cyclotron resonance devices in producing intense beams of energetic neutral particles is studied. It is shown that a two-fold increase in the present performance can be achieved for neutral-particle beams with energies less than 20 keV. The optimum region for coherent acceleration is determined. The influence of wavelength and uhf power on the performance is studied. Author (NSA)

N71-24979# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

VACUUM PROBLEMS ENCOUNTERED IN NUCLEAR FUSION RESEARCH [PROBLEMES DU VIDE DANS LES RECHERCHES SUR LA FUSION NUCLEAIRE]

F. Prevot Oct. 1970 29 p refs Presented at the 6th Symp. on Fusion Technol., Aachen, 22-25 Sep. 1970 Sponsored in part by Euratom

(EUR-CEA-FC-566; CONF-700928-6) Avail: AEC Depository Libraries

Research in plasma physics and future developments in fusion power plants pose important vacuum technique problems, which are briefly reviewed. The characteristics of these problems are constrasted with conventional vacuum technology. Author (NSA)

N71-25028*# Rensselaer Polytechnic Inst., Troy, N.Y. Plasma Dynamics Lab.

INSTABILITIES AND TURBULENCE IN HIGHLY IONIZED PLASMAS IN A MAGNETIC FIELD Semiannual Status Report, 1 Sep. 1970 - 28 Feb. 1971

J. H. Noon and W. C. Jennings Apr. 1971 60 p refs

(Grant NGR-33-018-137)

(NASA-CR-118311; TR-71-1) Avail: NTIS CSCL 20I

Further work was carried out on correlation length and time studies of the plasma turbulence spectrum in the highly ionized argon arc. New probe diagnostics were developed to allow improved measurements of radial, azimuthal, and axial parameters. The relation between wave growth in different frequency regions of the spectrum and the sense of energy cascade has been studied both experimentally and theoretically. The technique used can also be applied to determine whether classical or anomalous diffusion across the magnetic field is dominant. An optical diagnostic method was developed for remote sensing of coherent instabilities and a feedback scheme has been successfully applied to stabilize the plasma against the development of these coherent instabilities. A theoretical analysis shows promise in explaining the underlying mechanisms responsible for wave growth in different radial regions of the inhomogeneous plasma. Author

N71-25031 Stanford Univ., Calif.

COMPUTER STUDIES OF PLANAR PLASMA CONFIGURATIONS

Robert Daniel Burn, Jr. (Ph.D. Thesis) 1969 75 p

Avail: Univ. Microfilms Order No. 70-10435

Three computer models simulating the motion of a plasma in both one and two dimensions were applied to the sheet or planar pinch. Both the relativistic regime, including field retardation effects, and the non-relativistic regime were investigated. In all cases both electric and magnetic interactions were allowed. The sheet pinch was completely stable both to spreading and fast wave instabilities, but exhibited tearing-mode instabilities in the slow wave regime. Typically, the tearing consisted of an initial breakup into multiple strands which subsequently underwent coalescence. Dissert. Abstr.

N71-25038# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

FILLING OF A MAGNETIC WELL BY INJECTION OF NEUTRAL ATOMS AT VARIOUS ANGLES AND ENERGIES [REMPLISSAGE D'UN PUITS MAGNETIQUE PAR INJECTION D'ATOMES NEUTRES AVEC DISPERSION DES PARTICULES EN ANGLE ET EN ENERGIE]

R. Dei-Cas and F. Hennion Nov. 1970 54 p refs In FRENCH Sponsored by part FRENCH Sponsored in part by Euratom

(EUR-CEA-FC-563) Avail: AEC Depository Libraries

Numerical calculations concerned with filling a magnetic well (minimum B configuration) using multi-injection by ten sources at different angles are presented. The model enables spatial-temporal changes in density, anisotropy, and energy distribution to be studied. The real geometry of the magnetic field, ion pumping effects, and the bombardment of the walls by the particles are taken into consideration. Stable plasmas with densities up to the order of 10 to the 12th power/cu cm (omega sub pi/omega sub ci approximately 10) could be achieved with total currents of the order of 700 mA, when the initial residual pressure was 3 x 10 to the minus 8th power mm of Hg. With these injection conditions, the final characteristics of the plasma were: ion density at the center 10 to the 13th power/cu cm; plasma decay time 0.1 to 1 second; and mean ion temperature 10 keV. Author (NSA)

N71-25181# Army Foreign Science and Technology Center, Charlottesville, Va.

PHYSICAL ELECTRONICS AND PLASMA PHYSICS

18 Feb. 1971 19 p refs Transl. into ENGLISH from Fizicheskaya Elektron. i Fiz. Plazmy (Leningrad), 1968 p 3–19

(AD-719553; FSTC-HT-23-038-71) Avail: NTIS CSCL 20/9

A group of abstracts describes the activities of various groups at the A. F. Ioffe Institute of Physics and Technology, Academy of Sciences of the USSR. The fields covered include thermoelectric emission, secondary electron emission in semiconductors, development of new types of mass spectrometers, adsorption and desorption of particles, use of autoemission microscopy, collisions of atomic particles, plasma physics (especially microwave, probe, optical and spectroscopic methods of studying plasma, heating of a plasma in a magnetic field, studies of turbulent plasma) and electric explosions. GRA

N71-25183# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

EURATOM-CEA ASSOCIATION PLASMA PHYSICS AND CONTROLLED FUSION DEPARTMENT (GRENOBLE). PROGRESS REPORT OF THE RESEARCH GROUP FOR 1 APRIL 1969–28 FEBRUARY 1970 [ASSOCIATION EURATOM-CEA, DEPARTMENT DE PHYSIQUE DU PLASMA ET DE LA FUSION CONTROLEE. RAPPORT D'ACTIVITE DU GROUPE DE RECHERCHES, 2EME PARTIE: GRENOBLE POUR LA PERIODE 1er AVRIL 1969–28 FEVRIER 1970]

1970 118 p refs In FRENCH

(EUR-CEA-FC-542-Pt-2) Avail: AEC Depository Libraries

The scientific results obtained during 1969 and up until March 1970 by the Plasma Physics and Controlled Fusion Department of Grenoble are presented. The Department consists of the General Ion Technology Service and the Wave–Plasma Interaction Section. The following subjects were studied: turbulent diffusion, microinstabilities and stabilization using curvature and shear effects in the confining magnetic fields; the acceleration, confinement, and heating of a plasma using the pairing action of the high-frequency fields associated with the static magnetic fields in the region of a characteristic resonance (electron cyclotron or a lower hybrid); the stabilization of drift instabilities by the action of an oscillating electric field, parallel to the confining magnetic field; the properties of the plasmas; advanced technology, production of strong magnetic fields, cryogenic pumping, high power oscillators and the applications of optical methods to the microwaves. NSA

N71-25184# California Univ., Irvine.

OBSERVATION OF DIRECT NONLINEAR COUPLING OF ELECTROMAGNETIC WAVES AND ELECTROSTATIC WAVES IN A PLASMA

David Phelps, Nathan Rynn, and Gerard Van Hoven [1971] 16 p refs

(Grant NSF GP-24029)

(TR-70-36) Avail: Issuing Activity

Observation of direct second-order nonlinear coupling among electromagnetic and electrostatic waves in a potassium plasma column in a Q-machine is reported. The term direct means that the exciting waves and the interacting waves are the same. The coupling takes place in the volume of the column and not in the boundaries or in a locally resonant layer. The measurements are made under conditions that enabled the unambiguous determination of the wavelength, the frequency, the polarization, the field configuration, and the power levels of the interacting waves to be made. This photon-plasmon interaction was clearly observed in the laboratory and the complete properties of each interacting wave was simultaneously measured. Author

N71-25222# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

MHD EQUILIBRIUM AND STABILITY OF TOROIDAL PLASMAS WITH A QUASI-TRIANGULAR CROSS SECTION IN TOKAMAK TYPE MAGNETIC CONFIGURATIONS [EQUILIBRE ET STABILITE MHD DES PLASMAS TOROIDAUX DE SECTION TRANSVERSALE QUASI-TRIANGULAIRE DANS DES CONFIGURATIONS MAGNETIQUES DE TYPE TOKAMAK]

H. Luc Oct. 1970 34 p refs In FRENCH

(EUR-CEA-FC-569) Avail: AEC Depository Libraries

The MHD equilibrium of an axisymmetric toroidal plasma is studied. Its stability against local perturbations is strongly dependent upon the existence of triangular deformations (even slight) in its cross section. The displacement of the magnetic axis in relation to the central axis is not necessarily small and the plasma pressure may be near the equilibrium pressure limit. Author (NSA)

N71-25223# Columbia Univ., New York. Plasma Lab.

NUMERICAL STUDIES OF ION-ACOUSTIC COLLISIONLESS SHOCKS AND SOLITARY WAVES

Paulo H. Sakanaka 1970 111 p refs Supported in part by Conselho Nacl. de Pesquisas

(Contract AT(30-1)-3954; GRANT NSF GK-1391)

(CU-3954-7; Rept-52) Avail: NTIS

A numerical technique to solve the Vlasov-Poisson system of equations for ions with isothermal electron fluid was developed and tested. The phase-space grid points are assigned values of the ion distribution function. These values are moved along ion trajectories by the self-consistent electric field, and are reassigned to four grid points of the phase-space cell in which they fall, by an appropriate area-sharing method. Poisson's equation is solved by an iteration method or the Runge–Kutta method. The technique was applied to study the formation and the evolution of ion-acoustic collisionless shocks and solitary waves in a plasma with a high electron–ion temperature ratio. Author (NSA)

N71-25224# California Univ., Livermore. Lawrence Radiation Lab.

AN EXPERIMENTAL EVALUATION OF A PULSED, SUBMILLIMETER LASER INTERFEROMETER FOR TRANSIENT PLASMA DIAGNOSTICS

Alan L. Throop 10 Dec. 1970 14 p refs Sponsored in part by AEC

(UCRL-50983) Avail: NTIS

The application of a far-infrared interferometer to transient plasma diagnostics is described. The experimental performance of the interferometer under varying plasma conditions is presented. Detailed discussion is devoted to such important system parameters as observable density range, spatial resolution, time response, calibration techniques, and gamma radiation effects. Author (NSA)

N71-25234# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

REVIEW ON CORRELATION MEASUREMENTS IN PLASMA

M. Bernard, G. Briffod, J. P. Bussac, R. Frank, M. Gregoire et al Oct. 1970 25 p refs Presented at Symp. on Plasma Diagnostics, Sukhumi, USSR, May 1970

(EUR-CEA-FC-570; CONF-700548-1) Avail: AEC Depository Libraries

Two ways in which correlation techniques are particularly useful are presented: turbulent diffusion studies (measurement of particle losses and diffusion coefficients); and investigation of fluctuations and instabilities. In the first case it is necessary to measure the correlation time and correlation lengths of the fluctuating electric field as well as the correlation coefficient. In the second case, the measured autocorrelation and cross-correlation functions of the plasma parameters are time and space Fourier transformed. Hence, either the energy spectrum of the fluctuations and their

dispersion relation for a linear model or the structure of the wave packets for nonlinear cases, can be deduced. Correlation measurement systems and the experimental work are reviewed. The results which were obtained in the laboratory on a hydrogen diffusion plasma with static magnetic field are then more precisely described. Author (NSA)

N71-25235 Texas Univ., Austin.
LINE BROADENING IN RADIO FREQUENCY HYDROGEN PLASMAS
John David Tannich (Ph.D. Thesis) 1969 114 p
Avail: Univ. Microfilms Order No. 70-10873

The Stark broadened hydrogen Balmer lines emitted from a low density radio frequency discharge are measured in the laboratory and compared to calculated line profiles, quantitatively including the effects of Doppler and apparatus broadening by standard folding procedures. Theoretical Stark profiles, accounting for electron broadening in the classical path and impact approximations, form the basis for comparison. The results are likewise compared to line profiles calculated entirely within the formalism of the quasistatic theory. Here the effective electron broadening contribution is varied over the line profile according to an empirical formula. The theoretical prediction of structured line profile cores is verified. Finally, the investigations of the plasma light source revealed the presence of relatively strong high frequency modulation of the light intensity at multiples of the oscillator frequency; however, these fluctuations have no apparent effect on the line profile studies. Dissert. Abstr.

N71-25236 California Univ., San Diego.
PHYSICS, PLASMA ELECTRON PLASMA WAVE GROWTH
Paul L. Nunez (Ph.D. Thesis) 1969 100 p
Avail: Univ. Microfilms Order No. 70-8845

The transfer of energy from the particles of an electron beam to longitudinal plasma waves is here studied by means of plasma kinetic theory. The quasilinear theory of collisionless damping of plasma waves is presented and applied to the beam-plasma problem. The quasilinear equations for the evolution of the wave field energy and distribution function are analyzed. Numerical solutions of the quasilinear equations modified by spontaneous emission and two-body collision effects are obtained. It is shown that except for logarithmic dependences the solutions depend on two parameters, the constant part of the diffusion coefficient and the spontaneous emission coefficient. The evolution of the resonant field energy density and distribution function are presented for various combinations of these parameters. Finally, a summary of the various phenomena that may limit the growth of the resonant field energy in a plasma containing an electron beam is presented. Dissert. Abstr.

N71-25439*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOME LIMITATIONS ON ION-CYCLOTRON WAVE GENERATION AND SUBSEQUENT ION HEATING IN MAGNETIC BEACHES
Donald R. Sigman Washington May 1971 20 p refs
(NASA-TM-X-2263; E-6080) Avail: NTIS CSCL 20I

Thermal effects are included in the analysis of ion cyclotron waves generated by a Stix coil. Peak power coupling efficiency is reduced whenever ion or electron temperatures are sufficient for ion cyclotron or Landau damping to occur. Because of the absorption of wave power under the coil, the wave power reaching an external magnetic beach is reduced. The effect of a Faraday shield on power coupling and wave damping, and the interference effects which arise when waves are reflected from the ends of the plasma column are also discussed. Author

N71-25526*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEUTERIUM-HELIUM 3 FUSION POWER BALANCE CALCULATIONS
John J. Reinmann and Warren D. Rayle Washington May 1971 41 p refs
(NASA-TM-X-2280; E-6104) Avail: NTIS CSCL 20I

Steady-state operating parameters were calculated for the deuterium helium-3 cycle. Energy equations were written for the electrons and the two ion species in the plasma. The effects of varying amounts of reflection and reabsorption of cyclotron radiation were studied by the inclusion of a variable cyclotron radiation parameter. Other parameters were varied to assess the effects of: (1) unequal confinement times of plasma electrons and ions, (2) plasma ion heating by fusion products at an enhanced rate, and (3) injection of fuel ions with varying amounts of initial energy. Results are presented in the form of equilibrium values of a containment parameter, the electron and ion temperatures, and a breakdown of the output power into bremsstrahlung, cyclotron radiation, and power carried out by escaping ions and electrons. Results are plotted as a function of plasma ion temperature. Author

N71-25575# Japan Atomic Energy Research Inst., Tokyo.
JOULE HEATING IN JFT-2
Tatsuoki Takeda and Satoshi Itoh Oct. 1970 20 p refs
(JAERI-Memo-4186) Avail: AEC Depository Libraries

The time dependence of the plasma parameters in JFT-2 was investigated numerically. The calculations were carried out by solving the simultaneous differential equations composed of circuit equations and plasma energy-balance equations. Necessary one-turn resistance of a liner and the dependence of ion temperature and thermal conduction time on plasma parameters were obtained. Author (NSA)

N71-25576# Oak Ridge National Lab., Tenn.
ELECTRON DISTRIBUTION MEASUREMENTS IN A HOT ELECTRON, MIRROR CONTAINED PLASMA
W. B. Ard, W. A. Hogan (Fla. Atlantic Univ.), and R. F. Stetson (Fla. Atlantic Univ.) Feb. 1971 16 p refs Submitted for publication
(ORNL-TM-3302) Avail: NTIS

Electron distributions in the afterglow of a hot electron, mirror-contained plasma are measured as a function of time by analysis of the bremsstrahlung spectra. The distributions are compared to those derived from a computer model which follows the cooling and scattering of electrons by ions and neutral molecules. It is found that, although scattering of neutrals is an important process in cooling the electrons in this plasma, the major loss mechanism is scattering into the loss cone. Author (NSA)

N71-25594# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
SPACE-TIME EVOLUTION OF A TOKAMAK-TYPE PLASMA
C. Mercier and Soubbaramayer 1970 4 p refs Presented at the 4th European Conf. on Controlled Fusion and Plasma Phys., Rome, 31 Aug.–4 Sep. 1970 Sponsored in part by Euratom
(CEA-CONF-1595; CONF-700817-20) Avail: AEC Depository Libraries

A mathematical model was set up to compute the space-time evolution of a Tokamak type plasma. Two examples of applications show that the model can be used to do extrapolation calculations of Tokamak machines or to carry out numerical experiments to test possible interpretations of measurements. Author (NSA)

N71-25687# Texas Univ., Austin.
QUASISTATIC ION CYCLOTRON WAVE STUDIES Final Report
D. G. Swanson 15 Nov. 1970 16 p refs
(Contract AT(40-1)-3871)
(ORO-3871-6) Avail: NTIS

Quasi-static ion cyclotron waves in plasmas with electron densities were studied. This study demonstrated the possibility of using these waves to heat plasmas at harmonics of the ion cyclotron frequency at low densities. The effect of collisions was examined. NSA

N71-25598# Columbia Univ., New York.
MODIFIED PARTICLE-IN-CELL METHOD FOR COLLISIONAL PLASMAS
C. K. Chu, W. P. Gula, and R. J. Mason (Bell Telephone Labs., Inc., Whippany, N.J.) [1970] 17 p refs Presented at the 4th Conf. on Numerical Simulation of Plasmas, Washington, D.C., 1970
(Contract AT(30-1)-3954)
(CU-3954-6; CONF-701113-4) Avail: NTIS

A modification of the standard simulation codes is proposed in which each simulation particle is interpreted as an element of phase space, with the value of the distribution function attached. For a collisionless plasma, this value is constant for each particle; when collisions are present, this value is modified according to the collision operator. One-dimensional problems are considered, and the Krook model operator is used for the collisions. Results are obtained for shock-wave formation in a rarefied neutral gas and for collisional damping of the two-stream instability in a plasma. Author (NSA)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N71-24368# Brown Univ., Providence, R.I. Div. of Engineering.
THEORETICAL STUDIES OF DEFECT MOTION IN CRYSTALS Final Technical Report, 1 Feb. 1969–31 Aug. 1970
Jerome H. Weiner 23 Oct. 1970 9 p refs
(Grant AF-AFOSR-1738-69)
(AD-718985; AFOSR-TR-71-0241) Avail: NTIS CSCL 20/12

A final technical report on the work done under the Grant is presented. The principal accomplishments described are: (1) The development of a new quantum rate theory for the motion of defects in crystals which includes thermal activation and quantum mechanical tunneling on an equal footing. (2) The development of a new method for the numerical solution of the time-dependent Schrodinger equation which is substantially faster (by a factor of about 30) than previously available methods. Author (GRA)

N71-24381# Pennsylvania State Univ., University Park. Materials Research Lab.
INVESTIGATION OF NUCLEATION SITES IN GELS Final Report, 6 Nov. 1967–30 Nov. 1970
Heinz K. Henisch 21 Dec. 1970 25 p refs
(Contract F19628-68-C-0109)
(AD-718984; AFCRL-71-0039) Avail: NTIS CSCL 20/2

The report gives a survey of work on the mechanism of crystal nucleation in gels and the various factors which influence it: heterogeneous nuclei and gel structure. It shows how both factors can in principle be controlled, through the use of so-called hybrid growth systems and a recently devised process known as gel gettering. The report also describes research on seeding and reimplanation processes, their problems and potentialities, and discusses the special role of cusps in controlling crystal growth in the gel medium. It concludes that the method is inherently capable of further development and makes three proposals for future research. Author (GRA)

N71-24382# Massachusetts Inst. of Tech., Cambridge.
BAND STRUCTURE AND ELECTRICAL PROPERTIES OF AMORPHOUS SEMICONDUCTORS Semiannual Technical Report, 1 Jul.–31 Dec. 1970
David Adler 31 Dec. 1970 10 p refs
(Contract DAHC04-70-C-0048; ARPA Order 1562)
(AD-718793; AROD-9181-5-P; SATR-1) Avail: NTIS CSCL 20/12

The rf sputtering is complete and high-quality films are being prepared by integrated circuit photolithographic techniques. The films have proven very strain sensitive and somewhat sensitive to variations in composition. The effective charge of the ions in the amorphous state has been determined from previous NMR results. More detailed NMR experiments and EPR experiments are being planned, in order to test the recent theoretical models. Amorphous and crystalline Si_2Te_3 films have been deposited in preparation for a comparison of their electrical and optical properties. Thermal effects at low temperatures and the radial temperature distribution of a threshold switch in the ON state are being investigated. A review of recent work in the field is nearing completion, and a review of the possible switching mechanisms has been completed. The basic ban model for amorphous semiconductors has been generalized to include electron-electron and electron-phonon interactions. Accurate solutions of the thermal model for switching have been obtained and an explanation for optical switching has been proposed. Author (GRA)

N71-24383# California Univ., Los Angeles. School of Engineering and Applied Science.
INTERFACE PHENOMENA IN INTEGRATED CIRCUIT OXIDES Final Report, 3 Mar. 1968–3 May 1970
Cadambanguidi R. Viswanathan and Seiki Ogura Dec. 1970 79 p refs
(Contract DAAB07-68-C-0203)
(AD-719283; UCLA-70-80; ECOM-0203-F) Avail: NTIS CSCL 20/12

The instability in MIS devices, arising due to mobile positive ions in the insulator layer was investigated experimentally and theoretically. A direct measurement of the built-in voltage in the MIS structure, viz., the voltage existing across the insulator due to interface effects, was shown to be possible using the photoelectric technique. The diffusion of ions in the oxide layer was studied and the results point out to the conclusion that the mobile ions tend to be localized either near the metal interface or near the silicon interface. Of these two, the sites near the metal interface have a larger activation energy and as such, the ions stay predominately near the metal interface. Calculations of the potential in the oxide layer, in the presence of mobile ions were carried out and found to give reasonable agreement with experimental results. The role of impurities like Al and Au was also studied. Interface Characteristics and the number of mobile ions and the number of traps were also studied for a chemically grown MNS sample. A number of problem areas requiring further investigation is also pointed out. Author (GRA)

N71-24640# Stanford Univ., Calif. Center for Materials Research.
RESEARCH ON AMORPHOUS MATERIALS Semiannual Technical Report, 1 Jun.–30 Nov. 1970
W. E. Spicer, A. Bienenstock, and R. H. Bube 30 Nov. 1970 39 p refs
(Contract DAHC04-70-C-0044; ARPA Order-1562)
(AD-719419; SU-CMR-71-3) Avail: NTIS CSCL 20/12

The report describes the first six months efforts to study the relationships among structure, bonding, electronic structure and transport properties of amorphous semiconductors. It deals, first with structural studies of Ge-Te alloys, doped as As_2Se_3 and group 4 elements. The second portion of the report describes optical and

photoemission studies of some of these materials, and the third section deals with transport properties of more complex systems. Author (GRA)

N71-24821*# Scientific Translation Service, Santa Barbara, Calif.
THE INFLUENCE OF THE CRYSTAL CHEMISTRY FACTOR ON THE SEPARATION OF RARE EARTH ELEMENTS IN CRYSTALLIZATION DIFFERENTIATION OF SILICATES [VLIYANIYE KRISTALLOKHIMICHESKOGO FAKTORA NA RAZDELENIYE REDKOZEMELNIKH ELEMENTOV V PROTSESSE KRISTALLIZATSIONNOY DIFFERENTSIATSII SILIKATOV]
Yu. A. Balashov et al Washington NASA May 1971 8 p refs Transl. into ENGLISH from Geokhimiyah (USSR), no. 7, 1970) p 855–858
(Contract NASw-2035)
(NASA-TT-F-13647) Avail: NTIS CSCL 20K

Experiments substantial the influence of crystal chemistry factors in the distribution of rare earth elemeny in crystallization differentiation of silicates. These factors are the type of crystal structure and the dimensions of the ions of interchangeable elements. E.M.C.

N71-24848# Signals Research and Development Establishment, Christchurch (England).
ION IMPLANTATION OF ZINC SULPHIDE THIN FILMS
M. R. Brown, A. F. J. Cox, W. A. Shand, and J. M. Williams Aug. 1970 7 p refs
(AD-718989; SRDE-70046; TRC-BR-23-132) Avail: NTIS CSCL 20/12

The report considers the use of ion implantation as a means of preparing rare earth doped thin films of zinc sulphide, and presents preliminary results on the luminescence of such films doped with Tb and Er166 ions. Author (GRA)

N71-24881# Cornell Univ., Ithaca, N.Y. School of Electrical Engineering.
MICROWAVE METHODS OF STUDYING SEMICONDUCTING MATERIALS Final Report
Donald W. Griffin (Adelaide Univ.) Griffiss AFB, N.Y. RADC Feb. 1971 183 p refs Supported in part by Radio Res. Board of Australia
(Contract F30602-68-C-0075)
(AD-719869; RADC-TR-71-28) Avail: NTIS CSCL 20/12

The normalized impedance transformation approach, which is a general procedure for the analysis of microwave reflection and cavity methods of measuring the properties of materials, is presented. The material, whose resistivity and permittivity are unknown, is regarded as one layer in an assembly of layers shaped to fit the cross-section of, and placed with its parallel interfaces normal to the axis of the cylindrical waveguide used in the measuring apparatus. Several of the methods suitable for determining semiconductor resistivity are analysed, and results are presented for specimen resistivities in the range 0.0001 to 10,000 ohm-cm and specimen thickness in the range 10 to 100,000,000 A. Bimodal waveguide methods of studying the properties of semiconducting materials are reviewed and the bimodal cavity method is selected for detailed consideration. Expressions for the propagation constants of circularly-polarized waves in semiconductor-filled bimodal waveguide subject to a longitudinal magnetic field are obtained. They are used in the application of the normalized impedance transformation approach to the analytical problem of relating the measurable properties of the bimodal cavity to the physical properties of the specimen under study. Author (GRA)

N71-24882# Maryland Univ., College Park. Dept. of Physics.
ELECTROMAGNETIC AND CRITICAL PHENOMENA IN SOLIDS Final Report
Richard A. Ferrell and Richard E. Prange 2 Feb. 1971 6 p refs
(Grant AF-AFOSR-1458-68)
(AD-719856; AFOSR-TR-71-0109) Avail: NTIS CSCL 20/12

The objectives of the grant, Electromagnetic and Critical Phenomena in Solids is described. These include the study of fluctuations both near a critical point, and as measured by electromagnetic probes. Considerable success was had in dealing with critical fluctuations by methods of dynamical scaling, notably the method of mode decoupling was introduced and applied. Experiments were proposed and analyzed to deal with special quantum waves and states in metals. Further, work was accomplished elucidating the optical properties of solids. Author (GRA)

N71-24976*# National Bureau of Standards, Washington, D.C. Electronic Technology Div.
METHODS OF MEASUREMENT FOR SEMICONDUCTOR MATERIALS, PROCESS CONTROL, AND DEVICES Quarterly Report, 1 Jul.–30 Sep. 1970
W. Murray Bullis, ed. Apr. 1971 60 p refs Sponsored in part by DASA, AEC, and Navy
(NASA Order S-70003-G)
(NASA-CR-118271; NBS-TN-571) Avail: NTIS; SOD $0.60 CSCL 20L

The NBS activities directed toward the development of methods of measurement for semiconductor materials, process control, and devices are described. Work is continuing on measurement of resistivity, carrier lifetime, and electrical inhomogeneities in semiconductor crystals; specification of germanium for gamma-ray detectors; evaluation of wire bonds, metallization adhesion, and die attachment; measurement of thermal properties of semiconductor devices and electrical properties of microwave devices; and characterization of silicon nuclear radiation detectors. New effort is being started on the measurement of transit-time and related carrier transport properties in junction devices. Supplementary data concerning staff, standards committee activities, technical services, and publications are included. Author

N71-25180# Army Foreign Science and Technology Center, Charlottesville, Va.
PLASTIC DEFORMATION AND DISLOCATION DENSITY IN CRYSTAL GROWING BY MEANS OF THE BRIDGEMAN METHOD [PLASTICHESKAYA DEFORMATSIYA I PLOTNOST DISLOKATSII PRI VYRASHCHIVANII KRISTALLOV METODOM BRIDZHMENA]
S. V. Tsivinskii et al 30 Oct. 1970 19 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (Moscow), v. 28, no. 3, 1969 p 487–495
(AD-719575; FSTC-HT-23-1117-70) Avail: NTIS CSCL 20/2

An equation is proposed for the approximate calculation of dislocation density in slightly deformed crystals. The equation is used for determination of dislocation density in crystals grown by Bridgemans method. The values of dislocation density agree with the experimental data. Author (GRA)

N71-24388# Messerschmitt-Boelkow G.m.b.H., Ottobrunn (West Germany).
DYNAMIC TESTING OF HELICOPTER COMPONENTS [DYNAMISCHE ERPROBUNG VON HUBSCHRAUBERKOMPONENTEN]
H. Schumacher *In* DGLR Helicopter Fatigue Testing Dec. 1970 p 97–123 In GERMAN (See N71-24385 13-02)
Avail: NTIS; ZLDI Munich: 38.85 DM

A survey is given of the essential dynamic tests in connection with the development of the Messerschmitt-Boelkow BO 105 helicopter, as an example of a testing program, which may be more generally applied to helicopter development. ESRO

The forward current and noise current of a p-n junction under a silicon dioxide layer have been measured before and after irradiation with ionizing radiation. Within a certain bias voltage range, both these currents have peak values that depend on the irradiation, and can be attributed to the effects of energy states in Si-SiO2 interface. These states have various time constants that can be related to their noise spectra, and depend on their energy level and the amount of band distortion at the interface. Alteration of the band bending produces 1/f-noise that deviates from the normal straight line graph with a peak at 900 Hz. The effect of the Si-SiO2 interface states on the surface recombination velocity is also investigated. Author

N71-25322*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ADVANCES IN COMPLEMENTARY MOSFET TECHNOLOGY
David H. Schaefer *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 281–282 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 20L

Large scale integrated metal-oxide-silicon-field-effect-transistor (MOSFET) units have been fabricated with up to 3000 devices on a chip. Complementary MOSFET technology employs both p- and n-type devices connected such that there is never a dc current flow from the power supply to the ground. Silicon chips that contain both n and p-type MOSFET's and n-p-n and n-n-p bipolar transistors require the driving of large currents. On aluminum foil deposited MOSFET inverters utilizing tellurium for the p-type device and cadmium selenide for the n-type device are proposed for large scale integrated circuit units. G.G.

N71-25323*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LOW FLUX LEVEL NEUTRON EFFECTS ON MOSFETS
Phillip A. Newman *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 283–285 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 20L

MOSFETS irradiation from a Pu-239 Be source produced shifts in gate threshold voltages that fit a power law closely. The observed power law dependence makes it possible to predict a shift of about 50 mV due to neutrons in the gate threshold voltage during a typical 5 year deep space mission that uses a radioisotope thermoelectric generator for power supply. G.G.

N71-25324*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLID STATE SHIFT REGISTER AS A DATA STORAGE DEVICE
John C. Lyons *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 286–288 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 20L

Design and fabrication of a shift register for data storage that consists of 128 binary digits on a single chip are reported. Each shifting bit is made up of a master flip-flop that utilizes p-channel MOSFET switches and p-channel MOSFET resistors. The chip occupies a volume of 0.024 cubic inch and weighs 0.25 g. An experimental circuit made up of more than 2,000 p-channel MOSFET had a power dissipation of approximately 600 mW per bit. G.G.

N71-25330*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLID STATE DETECTOR DEVELOPMENTS
Donald J. Williams *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 306–310 refs (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 20L

Surface barrier detectors and avalanche diodes in improved low energy particle detection systems are considered. Test results show that energy thresholds of 15 keV can be routinely maintained with surface barrier detectors at room temperatures. Comparison with the electron efficiency of an avalanche diode device found a similar efficiency curve; however, a dead layer problem was discovered with very poor energy resolution characteristics. The latter device is capable to operate over a wide range in temperatures. G.G.

N71-25377*# New Mexico Univ., Albuquerque. Bureau of Engineering Research.
A STUDY OF METAL INSULATOR SEMICONDUCTOR MAGNETORESISTANCE, BULK, AND SURFACE PROPERTIES OF INDIUM ANTIMONIDE
T. W. Kim and W. W. Grannemann Mar. 1971 45 p refs
(Grant NGR-32-004-002)
(NASA-CR-118330; PR-97(71)NASA-028) Avail: NTIS CSCL 20L

Maximum theoretical limits and expected experimental results were obtained before fabrication and measurement of the magnetoresistance MIS devices. Calculations from the given data involved the corbino disk magnetoresistance MIS thin-film transistor, magnetoresistance of the MIS thin-film device, and MIS corbino disk magnetoresistance. The vacuum system responsible for the research is under modification to improve the capability for vacuum deposition of the compound materials. The electron beam source and its control system will be adapted to the vacuum system. E.M.C.

N71-25440# Canterbury Univ., Christchurch (New Zealand). Dept. of Physics.
INTERACTION EFFECTS IN SOLIDS USING TRANSITION METAL AND RARE EARTH IONS AS PROBES Final Scientific Report, 1 May 1967–31 Aug. 1970
B. G. Wybourne and G. D. Jones 4 Dec. 1970 9 p refs
(Grant AF-AFOSR-1275-67)
(AD-719868; AFOSR-TR-71-0294) Avail: NTIS CSCL 20/12

The report summarizes research conducted in the Physics Department of the University of Canterbury, Christchurch, New Zealand in solid state physics during the period 1967-1970 with the support of the grant AF-AFOSR-1275-67. The research described falls under the headings: Localized modes of crystal lattices; Jahn-Teller interactions; Far-infrared and Raman spectroscopic studies; Spectroscopic properties of palladium and platinum group complexes; study of phase transitions using impurity ions as probes; and Theoretical studies. Author (GRA)

N71-25451# Washington State Univ., Pullman. Dept. of Physics.
EQUATION OF STATE OF SOLIDS Technical Summary Report, 8 Jan.–31 Dec. 1969
G. E. Duvall, C. T. Tung, S. M. Taylor, Jr., and D. P. Dandekar Jan. 1971 72 p refs
(Contract DA-04-200-AMC-1702/X/)
(AD-719307; WSU-SDL-70-02; BRL-CR-24; TSR-4) Avail: NTIS CSCL 20/12

An attempt was made to derive the degeneracy factor of Eyrings Significant Structure Theory for a particular model of a solid with vacant lattice sites. A form was obtained which differs from that obtained by Eyring and which gives results less satisfactory than Eyrings factor when compared with Hugoniot data. Some equilibrium Hugoniot states are calculated for a mixture of two materials and the formulae are applied to combinations of quartz-like and polyethylene-like materials. Some elastic calculations are made for various composite configurations. It is noted that conditions of uniaxial strain are violated, and that the relations between mean pressure and volume are sensitive to the boundary condition on

the face of the composite. Conventional methods for reducing ultrasonic velocity data taken at high pressures require a priori knowledge of the compressibility as a function of pressure if elastic constants are to be calculated. An iterative procedure is outlined which makes it possible to determine the elastic constants provided only that ambient pressure values of thermal expansion coefficient, its temperature derivative, and specific heat at constant pressure are known. Author (GRA)

N71-25487# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRIC PROPERTIES OF ZINC SULFIDE FILMS IN STRONG ELECTRIC FIELDS AT LOW TEMPERATURES
A. G. Goldman et al 12 Nov. 1970 11 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 14, no. 3, 1969 p 391–395
(AD-719784; FTD-HT-23-570-70) Avail: NTIS CSCL 20/12

Low-temperature electric properties of sublimated zinc-sulphide electroluminescent films were investigated by the method of thermostimulated currents. The properties changing with the change in the applied voltage are divided into four regions which are marked as currents of the ohmic region, injection currents, currents in the stimulation process and stimulated currents. Electric properties of films in each of these regions are described and illustrated by the plots of thermostimulated currents. Author (GRA)

N71-25488# California Univ., Berkeley. Lawrence Radiation Lab.
ELECTRONIC STRUCTURE AND DIELECTRIC PROPERTIES OF CUBIC SEMICONDUCTORS
John P. Walker (Ph.D. Thesis) Nov. 1970 114 p refs
(Contract W-7405-eng-48)
(UCRL-20377) Avail: NTIS

The electronic structure and dielectric properties of various cubic semiconductors are explored using the empirical pseudopotential method. The semiconductors Si, Ge, GaAs, GaP, ZnS, ZnSe, and ZnTe, all of which have a face-centered cubic (zinc-blende) crystalline structure, are considered. The empirical pseudopotential is discussed as the method exists today. The method is applied to the above semiconductors; the resultant electronic energy eigenvalues and wave-functions are used to examine several aspects of the electronic behavior of semiconductors. Author

N71-25489 Lehigh Univ., Bethlehem, Pa.
ON THE CONSTITUTIVE RELATIONS FOR ANISOTROPIC MATERIALS: TRICLINIC, MONOCLINIC, RHOMBIC, TETRAGONAL, HEXAGONAL CRYSTAL SYSTEMS
Erhan Kiral (Ph.D. Thesis) 1969 72 p
Avail: Univ. Microfilms Order No. 70-10606

Constitutive relations which describe the response of single crystals belonging to the triclinic, monoclinic, rhombic, tetragonal, and hexagonal crystal systems are described. No restrictions as to the number and also the type of the arguments of the constitutive relations are made. However, the symmetry properties of the crystal under consideration impose restrictions on the form of the constitutive relations. The problem is to determine the most general form of the polynomial relations that will be invariant under each transformation associated with the crystal considered. The basic quantities which are linear combinations of the tensor components are used. The transformation procedure of the basic quantities proves to be simpler than that of the individual tensor components and they are less in number as far as transformation is concerned. The general form of the constitutive equations, regarding them as functions of all possible basic quantities associated with the crystal class considered are determined. Dissert. Abstr.

N71-25490* National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
TRANSVERSE PIEZORESISTANCE AND PINCH EFFECT ELECTROMECHANICAL TRANSDUCERS Patent
Wilhelm Rindner and Ernest E. Pitelli, inventors (to NASA) Issued 3 Nov. 1970 (Filed 19 Sep. 1968) 7 p Cl. 73-141; Int. Cl. G01l1/18
(NASA-Case-ERC-10088; US-Patent-3,537,305; US-Patent-Appl-SN-760927) Avail: US Patent Office CSCL 20L

A solid state force measuring electromechanical transducer formed of piezoresistive materials is described. The main crystallographic axis of the piezoresistive material forming the device is skewed with respect to the axis of the force to be measured. In addition, transverse surfaces (parallel to the force axis) may be doped so as to have high and low recombination velocities thereby enhancing the pinch effect to make the transducer more force sensitive. The force to be sensed and a bias voltage are both applied along the same axis and generate on the transverse surfaces a voltage that is sensed by a suitable voltage sensing means. The magnitude of the change in the transverse voltage is related to the magnitude of the applied force.
Official Gazette of the U.S. Patent Office

N71-25491# Grumman Aerospace Corp., Bethpage, N.Y. Materials and Structural Mechanics Section.
THEORETICAL CONSIDERATIONS IN THE REALM OF AMORPHOUS SEMICONDUCTORS
H. Kivlighn May 1971 23 p refs
(RM-506) Avail: NTIS

The theoretical aspects of semiconduction in the vitreous state from the viewpoint of chemical bonding were considered. The potential influence of multiple bonding on this phenomenon is discussed and related to an approach designed to increase this bonding characteristic within the vitreous state. A review of the literature and a description of the present state of the art are also presented. Author

N71-25502 Rutgers Univ., New Brunswick, N.J.
FLUCTUATIONS IN SUPERCONDUCTIVE FILMS IN A MAGNETIC FIELD
Martha Harper Redi (Ph.D. Thesis) 1969 95 p
Avail: Univ. Microfilms Order No. 70-10095

The effects of thermodynamic fluctuations of the superconductive order parameter have been studied for certain dynamical properties of superconductive films in a perpendicular magnetic field just above the transition point. The microscopic Matsubara thermal Green's function technique has been used to calculate the fluctuation conductivity and the effect on the tunneling density of states of superconductive films. The theoretical predictions are shown to agree with experiment. Dissert. Abstr.

N71-25504# Georgia Inst. of Tech., Atlanta. School of Chemical Engineering.
STUDY OF THE STRUCTURE AND MECHANICAL PROPERTIES OF ORDERED ALLOYS Technical Progress Report, 1 Jan. – 15 Dec. 1970
B. G. Le Fevre and E. A. Starke, Jr. Dec. 1970 64 p refs
(Contract AT(40-1)-3908)
(ORO-3908-2) Avail: NTIS

The phenomenon of order strengthening has been studied in the systems Ni3Mo and CuPt. Transmission electron microscopy of deformed polycrystalline specimens and quantitative X-ray diffraction measurements on single crystals were used to determine the deformation mechanisms, the cause of intergranular failure, and the domain size and internal strains produced during ordering. It was found that ordered Ni4Mo deforms by the motion of extended dislocations and that the root-mean-square strains determined by X-ray diffraction correlate directly with those calculated from yield strength measurements. A study of the relation between short range order and mechanical properties is also being conducted in this system, the progress on which is reported. In the system CuPt the results of microhardness measurements and optical metallography indicate that ordering strains are sufficient to produce recrystallization at the specimen surface and within the grain boundaries. Author (NSA)

N71-25531# Sandia Corp., Albuquerque, N.Mex.
CALCULATION OF HELIUM INDUCED STRAIN IN ErT2 AND ScT2
E. H. Farum Nov. 1970 23 p refs
(SC-RR-70-753) Avail: NTIS

A simple hard-sphere calculation of the volume of voids in the cubic CaF2 was made. The calculation was applied to ErT2 and ScT2 to determine the lattice-constant change caused by tritium decay and the subsequent trapping of He-3 in both the octahedral and tetrahedral voids. It is found that the calculation agrees reasonably well with experimental measurements in ErT2 film and bulk samples and ScT2 bulk samples if it is assumed that all He-3 atoms migrate to octahedral voids. Author (NSA)

N71-25539# Northeastern Univ., Boston, Mass. Solid State Chemistry Lab.
EXTENSIVE INTERSTITIAL SOLID SOLUTIONS OF METALS IN METALS
B. C. Giessen, R. Ray, and S. Hahn 14 Dec. 1970 13 p refs
(Contract N00014-68-A-0207-0003)
(AD-719940) Avail: NTIS CSCL 20/12

A new type of metallic solid solution has been prepared in which < or = to 12.5 at. pct. of comparatively small metal atoms (Cu) fill interstitial sites in a host metal composed of larger atoms (Y). At higher solute concentrations, both interstitial and substitutional sites are occupied. These solid solutions are metastable; they were formed by ultra-rapid quenching from the liquid. Author

N71-25547# Argonne National Lab., Ill.
THE POSSIBILITY OF USING A DEFECT FREE CRYSTAL STRUCTURE TO ACCELERATE CHARGED PARTICLES
A. A. Vorobev et al Apr. 1970 7 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Fiz. (Tomsk), no. 3, 1969 p 127-128
(ANL-Trans-825) Avail: NTIS

The complex problems of developing a crystal accelerator have, to a certain extent, been solved. The main part of the problem - obtaining a defect-free atomic structure - remains one of the main problems of modern physics. NSA

N71-25548# Virginia Univ., Charlottesville. School of Engineering and Applied Science.
FCC-BCC TRANSFORMATION IN THIN IRON FILMS
Gregory Hammond Olsen (Ph.D. Thesis) Dec. 1970 136 p refs
Sponsored by AEC
(ORO-3108-107) Avail: NTIS

Thin iron films were vacuum deposited on single crystal copper substrates in order to study the fcc-bcc transformation in iron. The orientation relationships of bcc iron precipitates which resulted from this transformation were experimentally determined and were found to change with thickness of the iron film. Energy arguments are advanced which enable the outcome of these transformations to be predicted according to the sense of the applied stress. Comparison with the experimental results showed that the energy arguments are a vital criteria for predicting the success of fcc-bcc transformations in thin iron films. Possible nucleation sites of bcc precipitates as well as the relationship of the above results to those of bulk specimens are discussed. Author (NSA)

N71-25549 Michigan State Univ., East Lansing.
EFFECT OF PHONON AND ELECTRON-ELECTRON INDUCED INTERBAND TRANSITIONS ON THE THERMOPOWER OF THE TRANSITION METALS, PART 1. LATTICE DYNAMICS OF CRYSTALS WITH MOLECULAR IMPURITY CENTERS, PART 2
Hans Rudolf Fankhauser (Ph.D. Thesis) 1969 133 p
Avail: Univ. Microfilms Order No. 70-9531

Using a two band model for the conduction electrons of the transition metals and assuming that only the lighter carriers contribute to charge transport the effects of phonon induced and electron-electron interband s-d transitions are investigated. The effect of the impurities are discussed and the theoretical total thermopower is compared with available experimental data. The use of symmetry properties results in a great saving of time and effort in the theoretical study in molecules and crystals and, frequently, the application of group theory leads to valuable qualitative conclusions. A group theoretical method to obtain the appropriate eigenvectors of the dynamical problem (normal modes) is presented in detail and compatibility conditions for the eigenvectors of the sub-groups are derived in a number of important cases. Dissert. Abstr.

N71-25561 Stanford Univ., Calif.
PHOTOTHERMOELECTRIC EFFECTS IN SEMICONDUCTORS
James George Harper (Ph.D. Thesis) 1969 136 p
Avail: Univ. Microfilms Order No. 70-10463

The photothermoelectric effects in silicon and semi-insulating GaAs are studied and it is shown that the effect can be used to study the transport properties of these materials. The effect was measured on samples characterized by photo-Hall measurements to relate carrier densities to the electronic part of the thermoelectric power. Results indicate that both the phonon-drag and electronic contributions to the thermoelectric power are changed by photoexcitation of carriers. In n-type Si, photoexcitation decreased the thermoelectric power. The results for a two-carrier material such as semiinsulating GaAs demonstrate that the thermoelectric power is electronic in nature and that band-gap photoexcitation changes the sign of the thermoelectric effect from positive to negative. Dissert. Abstr.

N71-25562 Virginia Polytechnic Inst., Blacksburg.
AN INFRARED ABSORPTION STUDY OF SILICON IMPLANTED WITH HIGH ENERGY NITROGEN IONS
Richard John Dexter (Ph.D. Thesis) 1970 71 p
Avail: Univ. Microfilms Order No. 70-9911

The donor ionization energy of high energy implanted nitrogen in silicon is studied by infrared spectroscopy and it is shown that the buried layer consists of silicon nitride and silicon oxynitride molecules. Infrared spectra of unannealed samples showed absorption peaks at 1.9, 2.7, 3.25, and 5.6 microns. These peaks can be annealed out at 760 C in a few minutes and are attributed to radiation damage effects in the silicon lattice. When fluences (i.e., time integrated flux) of less than 2×10 to the 16th power nitrogen ions per sq cm were used, peaks were observed which indicate that the ionization energy of the nitrogen donor in silicon might be as shallow as 45.8 MeV. Long, high temperature anneals on heavily bombarded samples formed an absorption peak at 11.7 microns which was assigned to silicon nitride and peaks at 10.2, 10.7, 11.0, 11.2 and 11.5 microns which were assigned to silicon oxynitride molecules. Dissert. Abstr.

N71-25563 Cornell Univ., Ithaca, N.Y.
THERMALLY STIMULATED CONDUCTIVITY OF IRRADIATED ALKALI HALIDES
Peter Ronald Hanley (Ph.D. Thesis) 1969 170 p
Avail: Univ. Microfilms Order No. 70-5987

The thermally stimulated conductivity (TSC) is examined that is attributed to the release of charge from electronic and ionic defects during thermal annealing of single crystals of the alkali halides, KBr and NaCl. A Co-60 gamma ray source, or a monoenergetic neutron source employing the 7Li(p,n)7Be reaction, were used to create and/or excite these defects. Irradiations were performed at either 10 K and 77 K followed by linear rise annealing to room temperature. A field of 1000 volts per centimeter was applied to the crystal just before annealing. Using the observed annealing kinetics, defect identities are inferred by correlating data from optical absorption and thermoluminescence experiments. Dissert. Abstr.

N71-25584 Lehigh Univ., Bethlehem, Pa.
A DYNAMIC PIEZOELECTRIC THEORY FOR FERROELECTRIC CERAMIC SHELLS
Douglas Schaeffer Drumheller (Ph.D. Thesis) 1969 168 p
Avail: Univ. Microfilms Order No. 70-10591

Polarized ferroelectric ceramics are an important class of materials which exhibit a linear piezoelectric effect. Because of the large piezoelectric coupling, an analysis of ferroelectric shells requires the simultaneous solution of the field equations of elasticity and electrostatics which are coupled together by linear constitutive relations. A shell theory is derived by assuming an orthotropic material in which the principal axes of orthotropy coincide with the two principal directions of the reference surface and its normal. A given surface or edge of the shell may be either electroded or unelectroded, and in addition to the usual elastic boundary conditions of shell theory, the electrical quantities of surface potential, surface charge density, or total charge on an equipotential surface can be prescribed. Dissert. Abstr.

N71-25587 Stanford Univ., Calif.
ATTENUATION IN MICROWAVE ACOUSTIC TRANSDUCERS AND RESONATORS
Michael Theodore Wauk, I. (Ph.D. Thesis) 1969 210 p
Avail: Univ. Microfilms Order No. 70-10546

The behavior of microwave acoustic thin film devices and the effects of ultrasonic attenuation on this behavior are studied. Both theoretical and experimental results are presented which are relevant to longitudinal wave piezoelectric transducers and resonators which may be treated in a plane wave approximation. Approximately thirty-three materials are considered. Dissert. Abstr.

N71-25588 Virginia Polytechnic Inst., Blacksburg.
AN INFRARED ABSORPTION STUDY OF ALUMINUM ANTIMONIDE
John Herbert Wood (Ph.D. Thesis) 1970 51 p
Avail: Univ. Microfilms Order No. 70-9919

Absorptions observed in the infrared spectra of p-type aluminum antimonide, not intentionally doped, are identified as electronic transitions from the ground acceptor state to excited acceptor states. The acceptor states are attributed to the impurity carbon. Lithium doped n-type aluminum antimonide was observed to remain n-type. Lithium doped p-type aluminum antimonide did not change type nor were any absorptions observed that indicated acceptor levels in the 23 mev to 1700 mev region resulting from the doping. N-type aluminum antimonide when doped with copper becomes highly compensated, but not p-type. The infrared spectra of copper doped p-type aluminum antimonide failed to show any absorptions which are clearly attributable to copper. Dissert. Abstr.

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

No abstracts in this issue.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N71-24673# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Trauen, (West Germany). Abteilung Foerdertechnik und Versuchsanlagen.
EXPERIMENTAL INVESTIGATION OF FOUR-ON-ONE IMPINGING JETS FOR LIQUID PROPELLANT ROCKET ENGINES [EXPERIMENTELLE UNTERSUCHUNG EINES PENTADEINSPRITZSYSTEMS FUER FLUESSIGKEITSTRIEBWERKE]
G. Kosmas, W. Hartung, and W. Buschulte Jun. 1969 34 p refs In GERMAN; ENGLISH summary
(DLR-MITT-70-24) Avail: NTIS; ZLDI Munich: 11,20 DM

Cold flow studies on a four-on-one symmetric injector element at 90, 60, and 120 deg total impingement angle were conducted to define the major variables affecting mixing and distribution of injected water replacing the propellants. Investigations on the four-on-one injector element show a relation for optimum mixing. But in this case the total impingement angle between the two streams indicates a clear effect. A series of combustion tests with two propellant combinations was made. Author (ESRO)

N71-24674# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Elektrische Antriebe und Energieversorgung.
INVESTIGATION OF A HOLLOW CATHODE FOR ELECTROSTATIC ION THRUSTORS [UNTERSUCHUNGEN AN EINER HOHLKATHODE FUER ELEKTROSTATISCHE IONENANTRIEBE]
H. Bessling Dec. 1970 29 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-72) Avail: NTIS; ZLDI Munich: 8,80 DM

The mechanism of the keeper-cathode-system of the hollow cathode, the change from spot mode to plume mode, and the possibility of using the keeper as control element are investigated. The relation between the mass of the power supply and propellant mass of the neutralizer system depending on the discharge mode is shown. Author (ESRO)

N71-24724*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TESTS OF PERMANENT MAGNET AND SUPERCONDUCTING MAGNET MPD THRUSTERS
Dennis J. Connolly, Allen R. Bishop, and George R. Seikel [1971] 10 p refs Presented at the 7th Propulsion Joint Specialist Conf., Salt Lake City, 14 – 18 Jun. 1971; sponsored by AIAA
(NASA-TM-X-62827) Avail: NTIS CSCL 21C

A radiation cooled MPD thruster was tested with the magnetic field supplied by a permanent magnet. The magnet provided a field of 0.08 tesla at the cathode tip. At 25 KW arc power the maximum magnet temperature was 835 K. The total thruster weight was under 1 kg/kW. The MPD thruster was also tested with a superconducting magnet to investigate operation at varying magnetic field strengths up to 1 tesla. Some increase in power capability was obtained with increasing field. When this thruster was operated with argon propellant and a hollow cathode, arc efficiency was found to increase with applied magnetic field strength. At 1 tesla and 25 kW arc power, the efficiency exceeded 30 percent at 2000 sec specific impulse. Author

N71-24735*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATUS OF A FIVE-CENTIMETER-DIAMETER ION THRUSTER TECHNOLOGY PROGRAM
S. Nakanishi, W. C. Lathem, B. A. Banks, and A. J. Weigand [1971] 20 p refs Presented at the 7th Propulsion Joint Specialist Conf., Salt Lake City, 14 – 18 Jun. 1971; sponsored by AIAA
(NASA-TM-X-67828) Avail: NTIS CSCL 21C

A prototype auxiliary propulsion sub-system with an isolated single-tank propellant feed system and a 5-cm-diam ion thruster is described. Component tests defining additional design and

operating criteria showed that increasing aperture size of the enclosed cathode keeper improved propellant utilization efficiency. The thruster was operated at floating system potentials from 10 to 35 V for a range of neutralizer positions and power inputs. A hollow cathode has been restarted for over 2800 simulated duty cycles. Beam extraction capabilities of various glass grid designs are discussed. A structurally integrated thruster subsystem that has successfully undergone structural and performance tests, obtaining over-all efficiency of 29 percent at a power to thrust ratio of 138 W/mlb is also described. Author

N71-24736* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ROCKET ENGINE INJECTOR Patent
Samuel Stein, inventor (to NASA) Issued 5 Nov. 1968 (Filed 31 Oct. 1966) 6 p Cl. 60-240
(NASA-Case-XLE-03157; US-Patent-3,408,816; US-Patent-Appl-SN-591014) Avail: US Patent Office CSCL 21H

A method for maintaining the mass flow rate of propellant into a rocket combustion chamber substantially constant as propellant temperature changes is detailed. This is accomplished by automatically varying the cross sectional area of the injector orifice to accommodate changes in density, velocity and pressure. Official Gazette of the U.S. Patent Office.

N71-24927*# Martin Marietta Corp., Denver, Colo.
RESUPPLY/REPAIR OF SOLID OR HYBRID ATTITUDE PROPULSION SUBSYSTEMS. VOLUME 2: TECHNICAL STUDY Final Report, 1 July.–31 Dec. 1970
J. Michael Murphy and John M. Humphrey Apr. 1971 412 p refs
(Contract NAS8-26196)
(NASA-CR-118264; MCR-71-11-Vol-2) Avail: NTIS HC $6.00/MF $0.95 CSCL 21H

Technical aspects of the hybrid attitude propulsion system are analyzed in terms of optimum orbital resupply, and maintenance requirements. The configuration of the selected radiation-cooled molybdenum thrust chamber with long-duration and low-maintenance requirements is described. The selection of onboard spares, malfunction detection devices, and special tools are discussed with recommendations for additional study programs and new technology requirements. F.O.S.

N71-24937# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DYNAMICS OF LIQUID ROCKET ENGINES
V. A. Makhin et al 15 Dec. 1970 480 p refs Transl. into ENGLISH from the book "Dinam. Zhidkostnykh Raketnykh Dvigatelei" USSR, 1969 p 1–384
(AD-719774; FTD-HC-23-18-70) Avail: NTIS HC $6.00/MF $0.95 CSCL 21/8

The book discusses questions of the theory and calculations of certain dynamic processes which take place with variable parameters in liquid rocket engines and their major components. Primary attention is devoted to the description of the dynamic processes and the study of methods for the engineering calculation of these processes. The differential equations of motion of the working medium and of the moving parts of the individual components are used to describe the dynamic processes of liquid rocket engines(LRE). Theoretical LRE arrangements and their static characteristics are examined. Assuming the LRE to be potentially a dynamic system, the authors derive the equations of the dynamics of the powerplant primary components. The dynamics of the LRE automation elements are analyzed and the questions of automatic regulation, trimming, and retrimming of engines using the results of firing tests are studied. The oscillatory processes in the tubing lines are examined in detail; the influence of oscillations in the pneumatic and hydraulic lines on the stability of the LRE working process is determined. An analysis is given of the LRE startup processes and the effect of the thrust tailoff impulse (TTI) on the scatter of ballistic rockets. Original material used in the analysis of several engine elements and their control systems is presented. Author (GRA)

N71-25033*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
QUALIFICATION EVALUATION OF THE TOWER JETTISON MOTOR FOR THE APOLLO SPACECRAFT PROGRAM LAUNCH ESCAPE SYSTEM
B. J. Lee Washington Apr. 1971 111 p refs
(NASA-TN-D-6295; MSC-S-216) Avail: NTIS CSCL 22B

A summary is presented of the qualification test program (consisting of environmental testing and static test firing) of the Apollo tower jettison motor. In addition, the static-test-firing data are evaluated statistically with regard to the specifications. The environmental testing phase of the qualification test program was conducted by using 15 Apollo tower jettison motors divided into the following environmental test groups: (1) temperature cycling; (2) accelerated aging; (3) temperature cycling; (4) vibration testing, temperature cycling, and impact testing. The static-test-firing phase of the qualification test program was conducted by using 21 Apollo tower jettison motors of which 15 were tested environmentally and six were not tested environmentally. The 21 motors were assigned to three prefire-conditioning temperature groups: 20 F (nine motors), 70 F (five motors), and 140 F (seven motors). Each motor was static test fired at a nominal pressure altitude of 14.7 psia. From an analysis of the results of the qualification tests, it was confirmed that the tower jettison motor meets the requirements of the Apollo spacecraft program. Author

N71-25209# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE ASSEMBLY OF GAS TURBINE AIRCRAFT ENGINES (SELECTED CHAPTERS)
V. I. Sokolov et al 10 Dec. 1970 102 p refs Transl. into ENGLISH from the publ. 'Sborka Aviatsionnykh Gazoturbinnykh Dvigateley' 1969 p 257–343
(AD-719823; FTD-HC-23-635-70) Avail: NTIS CSCL 21/5

While the units and subassemblies can be assembled both in an assembly shop and in the assembly sections of the combined and machine-assembly shops, the overall assembly of an engine is done only in an assembly shop. The overall assembly of engines, just as the assembly of units, consists of the preliminary intermediate and final assembly operations. In the process of conducting these operations, a check is made of the mutual arrangement of the parts and units; the axial, radial and diametral clearances and fits are established. These must comply with the technical specifications for the overall assembly of engines. The report discusses the overall assembly of three types of gas-turbine engines (GTE), differing significantly in design of basic units; therefore the preliminary intermediate and final assembly processes differ in respect to the methods used in these processes. Author (GRA)

N71-25213* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANNULAR SLIT COLLOID THRUSTOR Patent
Kenneth W. Stark, William A. Burton, and Allan Sherman, inventors (to NASA) Issued 8 Dec. 1970 (Filed 15 Jan. 1969) 6 p Cl. 60-202; Int. Cl. F03h5/00; Int. Cl. B05b5/02
(NASA-Case-GSC-10709-1; US-Patent-3,545,208, US-Patent-Appl-SN-791288) Avail: US Patent Office CSCL 21C

A microthrustor is described which uses the technique of flowing a slightly conductive propellant through an annular slit and the application of a high voltage causing a force on the fluid, resulting in the ejection of multimolecular particles at the meniscus of the fluid. Various configurations used include concentric bodies, windings of wire around a slit surface, and groups of thrustor

arrays producing beams of opposite polarities thereby eliminating the requirement for a neutralizer.
Official Gazette of the U.S. Patent Office

N71-25237*# Avco Corp., Lowell, Mass.
HYBRID RESISTOJET DEVELOPMENT Final Report
[1970] 115 p refs
(Contract NAS5-21080)
(NASA-CR-118322; AVSD-0083-71-RR) Avail: NTIS CSCL 21H

The experimental evaluation of several hydrazine thrusters which were ignited by electrical heaters within the thrust chamber indicated that high specific impulse (approximately 240 sec.) could be achieved during steady state operation without power addition, except for that required for ignition purposes. Restart capability was demonstrated with the various thrusters investigated. Pulsed operation of preprototype thrusters indicated that the specific impulse obtained for pulses on the order of 1 sec. duration decreased much more rapidly than that observed with nominal 5 lb catalytic hydrazine thrusters. A limited amount of experimental data for pulse widths of less than 0.1 sec., however, demonstrated that performance comparable to that of catalytic engines can be achieved at duty cycles greater than one percent. Author

N71-25360*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATUS OF THE 2 TO 15 kWe BRAYTON POWER SYSTEM AND POTENTIAL GAINS FROM COMPONENT IMPROVEMENTS
John L. Klann and William T. Wintucky [1971] 9 p refs Proposed for presentation at 1971 Intersoc. Energy Conversion Eng. Conf., Boston, 3-6 Aug. 1971 Sponsored by SAE
(NASA-TM-X-67835) Avail: NTIS CSCL 21E

System and component tests were continued with key components having passed 5000 hours of accumulated operating time. No basic technology problems were found. Based on the first system tests in a vacuum chamber, a net efficiency of 0.26 would be obtainable in space at 10 kW of useful electric power output; the specific radiator area would be about 75 sq ft/kW sub e. Minor system hardware changes are described which would improve system net efficiency to about 0.30 in the 10- to 15-kW range. Corresponding specific radiator areas would be 65 to 62 sq ft/kW sub E' An advanced Brayton power system operating at a turbine-inlet temperature of 2000 F was considered. If developed, it could offer a system net efficiency up to about 0.35 at its high power conditions; specific radiator area would drop to about 50 sq ft/kW sub e. Author

N71-25366*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
BOMBARDMENT THRUSTER INVESTIGATIONS AT THE LEWIS RESEARCH CENTER, 1971
Paul D. Reader and William R. Kerslake May 1971 16 p refs Presented at the 6th Symp. on Advan. Propulsion Concepts, Niagara Falls, N.Y., 4-6 May 1971
(NASA-TM-X-67836; E-6315) Avail: NTIS CSCL 21C

The current status of various research programs on mercury electron-bombardment thrusters is reviewed. Future thruster requirements predicted from mission analysis are briefly discussed to establish the relationship with present programs. Thrusters ranging in size from 5 to 150 cm diameter are described. These thrusters have possible near to far term applications extending from stationkeeping to primary propulsion. Included is a 5 cm thruster having a power to thrust ratio of 138 kW/lb; the 15 cm diameter SERT 2 thruster; and a 30 cm thruster designed to produce a 2.0 ampere beam at 3000 sec specific impulse. Research activities on thruster components are reported in the context of the various thruster programs. These include glass coated, single accelerator grids that have accumulated 1000 hr operating time; high current hollow cathodes of over 10 amperes emission; and, beam deflecting grid systems. Author

N71-25367*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POST TEST INSPECTION OF THREE BRAYTON ROTATING UNITS
James H. Dunn [1971] 14 p refs Proposed for presentation at 1971 Intersoc. Energy Conversion Eng. Conf., Boston, 3-6 Aug. 1971 Sponsored by SAE
(NASA-TM-X-67841) Avail: NTIS CSCL 21E

The NASA Lewis Research Center has assembled and is testing a closed Brayton cycle space electric power conversion system. This system was designed to produce 2 to 10 kW net continuous electric power for at least 5 yr. The turbine-alternator-compressor power conversion unit in this system is designated Brayton Rotating Unit (BRU). Four BRUs have been tested and have an accumulated running time in excess of 9000 hr. These tests have demonstrated that the unit has met or exceeded performance objectives. Yet to be verified are the design objectives for life. Two BRUs have been disassembled and inspected after substantial running time. One BRU has operated for 700 hr, another for 3000 hr. The bearings ran successfully with no detectable change in bearing operation or performance. However, minor pitting was found in the ball socket bearing pivots. Dimensional, electrical, and visual inspections revealed no other changes in the units. Author

N71-25368*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AUTOMATED ENDURANCE TESTING OF A BRAYTON POWER CONVERSION SYSTEM
R. E. Edkin, R. P. Macosko, and R. Kruchowy [1971] 12 p refs Proposed for presentation at 1971 Intersoc. Energy Conversion Eng. Conf., Boston, 3-6 Aug. 1971 Sponsored by SAE
(NASA-TM-X-67830) Avail: NTIS CSCL 21F

To demonstrate endurance of a 2-to-15 kWe Brayton power system, a test system was designed and constructed at the NASA, Lewis Research Center. The test system was designed to: (1) measure system and component performance; and (2) use a computer for monitoring and controlling a long term steady state endurance test. The system has been operated for more than 5300 hours under computer control; in excess of 4600 hours of testing were unattended by test personnel. During this time there have been no Brayton component failures and test support equipment problems have been minor in nature. The experience acquired in designing and working with such an automated test is discussed. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N71-24592# European Space Research Inst., Frascati (Italy).
HEATING OF THE SOLAR WIND IONS
N. D'Angelo and V. O. Jensen (RISO Res. Estab.) [1970] 5 p refs
(ESRIN-IN-135) Avail: NTIS

A new mechanism is described causing turbulent ion heating in the solar wind in the region about the earth which can explain the excess in ion temperature found to persist in that region. The mechanism is based on a flux of neutral hydrogen which is ionized near 1 A.U., causing an unstable ion distribution leading to electrostatic instabilities. ESRO

N71-24723*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PROPER 3C: A NUCLEON PION TRANSPORT CODE
Jules J. Lambiotte, Jr., John W. Wilson, and Tassos A. Filippas Washington Apr. 1971 131 p refs
(NASA-TM-X-2158; L-7326) Avail: NTIS CSCL 03B

A set of computer programs, referred to as the PROPER 3C Transport Code, has been written to calculate and analyze the interaction of nucleons and pions within a prescribed medium. The programs simulate the transport of nucleons and pions (with energies up to 2000 MeV) within a slab. The necessary nuclear interaction cross sections are read from a master data tape which contains cross-section data for various elements. The nuclear interaction data above 400 MeV are incomplete at this time but will be updated as data become available. A particle biography tape is generated and used to compile distributions for particles involved in the transport. Descriptions of the programs, detailed user's guides, and sample input and output for programs in the code are presented. Author

N71-24764*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COSMIC GAMMA RAYS
Floyd William Stecker Washington 1971 231 p refs
(NASA-SP-249) Avail: SOD $1.25; NTIS CSCL 03B

CONTENTS:

1. GAMMA-RAY PRODUCTION FROM THE DECAY OF SECONDARY PARTICLES PRODUCED IN COSMIC-RAY INTERACTIONS p 3-40 (See N71-24765 13-29)

2. GAMMA-RAY PRODUCTION FROM COSMIC ELECTRON-POSITRON ANNIHILATION p 41-52 (See N71-24766 13-29)

3. GAMMA-RAY PRODUCTION FROM COSMIC PROTON-ANTIPROTON INTERACTIONS p 53-76 (See N71-24767 13-29)

4. GAMMA-RAY ABSORPTION MECHANISMS p 77-86 (See N71-24768 13-29)

5. THE FORM OF THE COSMIC GAMMA-RAY PRODUCTION SPECTRUM FROM GALACTIC COSMIC-RAY INTERACTIONS FOR GAMMA-RAY ENERGIES LESS THAN 1 GeV p 87-108 (See N71-24769 13-29)

6. THE FORM OF THE COSMIC GAMMA-RAY PRODUCTION SPECTRUM FROM GALACTIC COSMIC-RAY INTERACTIONS FOR GAMMA-RAY ENERGIES GREATER THAN 1 GeV: THE EFFECT OF THE DECAY OF NUCLEON ISOBARS AND HYPERONS ON THE COSMIC GAMMA-RAY SPECTRUM p 109-124 (See N71-24770 13-29)

7. EQUILIBRIUM SPECTRA OF SECONDARY COSMIC-RAY POSITRONS IN THE GALAXY AND THE SPECTRUM OF COSMIC GAMMA RAYS RESULTING FROM THEIR ANNIHILATION p 125-148 (See N71-24771 13-29)

8. THE PRODUCTION OF GAMMA RAYS IN THE GALAXY p 149-170 refs (See N71-24772 13-29)

9. INTRODUCTION TO RELATIVISTIC COSMOLOGY p 171-178 (See N71-24773 13-29)

10. THE COSMIC GAMMA-RAY SPECTRUM FROM SECONDARY PARTICLE PRODUCTION OUTSIDE THE GALAXY p 179-186 (See N71-24774 13-29)

11. COSMIC GAMMA RAYS FROM EXTRAGALACTIC PROTON-ANTIPROTON ANNIHILATIONS p 187-192 (See N71-24775 13-29)

12. EXTRAGALACTIC GAMMA RAYS FROM COMPTON INTERACTIONS AND BREMSSTRAHLUNG p 193-200 refs (See N71-24776 13-29)

13. GAMMA-RAY ABSORPTION PROCESSES AT HIGH REDSHIFTS p 201-206 refs (See N71-24777 13-29)

14. POSSIBLE INTERPRETATION OF ISOTROPIC GAMMA-RAY OBSERVATIONS p 207-212 refs (See N71-24778 13-29)

15. GAMMA-RAY TELESCOPES D. Kniffen p 225-243 refs (See N71-24779 13-14)

N71-24765*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GAMMA RAY PRODUCTION FROM THE DECAY OF SECONDARY PARTICLES PRODUCED IN COSMIC-RAY INTERACTIONS
In its Cosmic Gamma Rays 1971 p 3-40 (See N71-24764 13-29)
Avail: SOD $1.25; NTIS CSCL 03B

The specific decay modes producing gamma rays in high energy interactions, the source functions, and the associated kinematics are discussed. Collision cross sections, directional intensity, and absorption effects are considered in the determination of gamma ray production spectra due to cosmic ray interactions with interstellar and intergalactic gas. The kinematics needed to describe the electromagnetic and weak decay reactions is developed using the special theory of relativity with four-vector algebra and the corresponding four-momenta and four-velocities. Source functions are evaluated for the following decay modes: pion(0) yields 2 gamma, Sigma hyperon(0) yields Lambda hyperon + gamma, kaon(0) sub 1 yields 2 pion(0) yields 4 gamma, kaon(+ or −) yields pion(+ or −) + pion(0) yields pion(+ or −) + 2 gamma, Lambda hyperon yields neutron + pion(0), Sigma hyperon(+) yields proton + pion(0), and the three body decay modes kaon(0) sub 2 yields 3 pion(0) and kaon(0) sub 2 yields pion(+) pion(−) pion(0). N.E.N.

N71-24766*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GAMMA-RAY PRODUCTION FROM COSMIC ELECTRON-POSITRON ANNIHILATION
In its Cosmic Gamma Rays 1971 p 41-52 (See N71-24764 13-29)
Avail: SOD $1.25; NTIS CSCL 03B

The annihilations are discussed using the results of quantum electrodynamics. Cross sections and annihilation rates are determined for the free positron annihilation with a free electron producing two gamma rays, and for the reaction between a positron and an electron of low energy forming positronium which then annihilates into two or three gamma rays. The gamma ray energy spectra of two-photon and three-photon annihilation of the electron positron pair are described. N.E.N.

N71-24767*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GAMMA-RAY PRODUCTION FROM COSMIC PROTON-ANTIPROTON INTERACTIONS
In its Cosmic Gamma Rays 1971 p 53-76 (See N71-24764 13-29)
Avail: SOD $1.25; NTIS CSCL 03B

Cross sections, selection rules, and the statistical Matsuda model are discussed for proton antiproton annihilation reactions. A real gas (RG) particle is defined as one with negligible kinetic energy with respect to the surrounding gas and a cosmic ray (CR) particle is one possessing relativistic energy. The emphasis is on RG-proton RG-antiproton and RG-proton CR-antiproton reactions. The gamma ray source spectrum, and the spectra from proton antiproton annihilations at rest and in flight are described. N.E.N.

N71-24768*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GAMMA-RAY ABSORPTION MECHANISMS
In its Cosmic Gamma Rays 1971 p 77-86 (See N71-24764 13-29)
Avail: SOD $1.25; NTIS CSCL 03B

The processes of astrophysical importance in depleting gamma rays in the galaxy and the universe are discussed. These absorption mechanisms include pair production processes and those in which the gamma ray is scattered out of the energy range of interest. Absorption of gamma rays in matter and absorption through interactions with radiation are considered. Author

N71-24769*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE FORM OF THE COSMIC GAMMA-RAY PRODUCTION SPECTRUM FROM GALACTIC COSMIC-RAY INTERACTIONS FOR GAMMA-RAY ENERGIES LESS THAN 1 GeV

In its Cosmic Gamma Rays 1971 p 87–108 (See N71-24764 13-29)

Avail: SOD $1.25; NTIS CSCL 03B

The gamma ray spectrum calculation is carried out for the energy region in which the analysis is complicated by the lack of a complete understanding of the various modes of pion production. First the general properties of gamma ray spectra from neutral pion decay are discussed, including the results of analytical and numerical calculations of normalized gamma ray spectra from ideal neutral pion energy distributions. A specific model is then chosen for the numerical calculation of the spectrum below 1 GeV. This model is of the isobar-plus-fireball type, and assumes that at accelerator energies there exist two dominant modes of pion production. These are the isobar component which dominates pion production in collisions where the cosmic ray protons have energies in the low GeV range, and the fireball component which supplies the main bulk of pions for p-p collisions of initial energy greater than 5 GeV.

Author

N71-24770*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE FORM OF THE COSMIC GAMMA-RAY PRODUCTION SPECTRUM FROM GALACTIC COSMIC-RAY INTERACTIONS FOR GAMMA-RAY ENERGIES GREATER THAN 1 GeV: THE EFFECT OF THE DECAY OF NUCLEON ISOBARS AND HYPERONS ON THE COSMIC GAMMA RAY SPECTRUM

In its Cosmic Gamma Rays 1971 p 109–124 (See N71-24764 13-29)

Avail: SOD $1.25; NTIS CSCL 03B

New accelerator data are used to calculate the cosmic gamma ray energy spectra caused by baryon decay and to determine at what gamma ray energies the decay of these particles may provide a significant source of cosmic gamma rays. The decay schemes are the neutral sigma decay producing one gamma ray directly, and the hyperon and nucleon isobars decays producing two gamma rays indirectly. The differential production cross sections of hyperon and nucleon isobar decay are calculated from proton accelerator experiments and cosmic ray shower studies. The cosmic gamma ray spectra are then obtained for decays of neutral Sigma hyperon; positive Sigma hyperon, Lambda hyperon, N*(1.410), and N*(1.688); and kaons and neutral pions created by the fireball processes.

N.E.N.

N71-24771*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

EQUILIBRIUM SPECTRA OF SECONDARY COSMIC-RAY POSITRONS IN THE GALAXY AND THE SPECTRUM OF COSMIC GAMMA RAYS RESULTING FROM THEIR ANNIHILATION

In its Cosmic Gamma Rays 1971 p 125–148 (See N71-24764 13-29)

Avail: SOD $1.25; NTIS CSCL 03B

Physical processes which must be considered in calculating the final positron annihilation gamma ray spectrum are discussed. The kinematics and recent calculations of the positron production spectrum from positive pion and radionuclei decay are presented. The equilibrium spectrum of secondary galactic positrons from pion decay is considered in order to obtain the in-flight annihilation gamma ray spectrum, and the annihilation gamma ray spectrum from cosmic ray positrons annihilating near rest is determined. The galactic positronium formation by fast positrions and the positron annihilation line intensity at 0.51 MeV are also considered.

N.E.N.

N71-24772*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE PRODUCTION OF GAMMA RAYS IN THE GALAXY

In its Cosmic Gamma Rays 1971 p 149–170 refs (See N71-24764 13-29)

Avail: SOD $1.25; NTIS CSCL 03B

The Compton interaction, bremsstrahlung, synchrotron radiation, and photomeson production mechanisms for galactic gamma ray production are discussed. Some of the theoretical calculations on galactic gamma ray production are related to the present observations. A plausible model for gamma ray production in the Milky Way is constructed which is consistent with the present data, and gamma ray production spectra in various parts of the galaxy are estimated.

Author

N71-24773*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

INTRODUCTION TO RELATIVISTIC COSMOLOGY

In its Cosmic Gamma Rays 1971 p 171–178 (See N71-24764 13-29)

Avail: SOD $1.25; NTIS CSCL 03B

The general theory of relativity and the Robertson–Walker form of the metric tensor in dimensionless spherical coordinates for an isotropic and homogeneous universe are reviewed briefly. The effect of cosmological factors in calculating photon fluxes emitted at large redshifts, z, is considered. The factor dl/dz, where dl is the dimensional length, is derived and evaluated for the Einstein–de Sitter model, the low-density model, and the more general case.

N.E.N.

N71-24774*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE COSMIC GAMMA-RAY SPECTRUM FROM SECONDARY PARTICLE PRODUCTION OUTSIDE THE GALAXY

In its Cosmic Gamma Rays 1971 p 179–186 (See N71-24764 13-29)

Avail: SOD $1.25; NTIS CSCL 03B

Cosmological formulas are used to determine the cosmic gamma ray spectrum from secondary particles produced by cosmic ray collisions in extragalactic space. Time dilatation, volume diminution, red shift, curvature effects, and the relation between redshift and radius of the universe are taken into account. Differential and integral spectra are given for the leakage and the burst models, along with the differential spectrum for the galactic halo.

N.E.N.

N71-24775*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

COSMIC GAMMA RAYS FROM EXTRAGALACTIC PROTON-ANTIPROTON ANNIHILATIONS

In its Cosmic Gamma Rays 1971 p 187–192 (See N71-24764 13-29)

Avail: SOD $1.25; NTIS CSCL 03B

The spectra of gamma radiation produced when antimatter and matter annihilate into mesons are discussed. The spectra are based on recent accelerator experiments on antiproton annihilation and include cosmological distortions of local annihilation spectra. Expressions are given for local annihilation gamma ray spectra for proton antiproton interactions and spectra exhibiting red shifts.

Author

N71-24776*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

EXTRAGALACTIC GAMMA RAYS FROM COMPTON INTERACTIONS AND BREMSSTRAHLUNG

In its Cosmic Gamma Rays 1971 p 193–200 refs (See N71-24764 13-29)

Avail: SOD $1.25; NTIS CSCL 03B

The cosmological effects are considered in computing the extragalactic gamma ray spectrum from Compton interactions between cosmic ray electrons and photons of the universal black body radiation field in intergalactic space. The cosmological bremsstrahlung production spectrum is obtained from the local gamma ray spectrum from relativistic bremsstrahlung interactions. Characteristics of predicted extragalactic gamma ray spectra are tabulated, and spectra of extragalactic electron and proton intensities are given for leakage, burst, and evolving source models. N.E.N.

N71-24777*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GAMMA-RAY ABSORPTION PROCESSES AT HIGH REDSHIFTS

In its Cosmic Gamma Rays 1971 p 201–206 refs (See N71-24764 13-29)

Avail: SOD $1.25; NTIS CSCL 03B

The way in which the effectiveness of absorption processes is enhanced at high red shifts due to increased photon and matter densities when the universe was in a more compact state is described. The processes are pair production interactions of cosmic gamma rays with the universal black body radiation field, Compton interactions of cosmic gamma rays with electrons in the interstellar or intergalactic gas, and pair production interactions of cosmic gamma rays with atoms of the interstellar or intergalactic gas. The energy dependences of the absorption processes are derived, taking cosmological factors into account. Author

N71-24778*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

POSSIBLE INTERPRETATION OF ISOTROPIC GAMMA-RAY OBSERVATIONS

In its Cosmic Gamma Rays 1971 p 207–212 refs (See N71-24764 13-29)

Avail: SOD $1.25; NTIS CSCL 03B

Gamma ray and X-ray spectra which follow the power law, and primordial gamma ray sources are discussed. Experimental data are reviewed and their implications are described. The gamma ray spectra indicate that extragalactic gamma radiation may be due to the decay of neutral pions produced in inelastic collisions of extragalactic cosmic ray protons and gas. The type of information which might be obtained from advanced gamma ray observations is outlined and includes evolution of quasars and galaxies, and intergalactic gas density. N.E.N.

N71-24949*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A DYNAMIC EQUATION FOR STOCHASTIC MAGNETIC FIELD LINES IN THE GALAXY

Frank C. Jones Apr. 1971 34 p refs Submitted for publication

(NASA-TM-X-65514; X-641-71-140) Avail: NTIS CSCL 03B

It is proposed that the turbulent motion of the ionized interstellar gas will cause a given line of force of the galactic magnetic field to wander in a random manner even though the average field may be quite regular. An equation is derived that describes the development of the probability density of a given field line as a function of distance along the average field. It is demonstrated that a Fokker–Planck type of equation is quite unsuitable in this case and that the answer must be sought in the theory of stationary Gaussian processes. The distribution function for the end points of a field line that starts on the galactic central plane is also derived. End points in this context means the point where the field line first wanders so near the surface of the galactic disk that it can no longer confine cosmic rays. Author

N71-24959*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AN UNUSUAL ABSORPTION FEATURE IN THE FAR UV SPECTRUM OF EARLY-TYPE SUPERGIANTS

A. B. Underhill, D. S. Leckrone, and D. K. West Apr. 1971 14 p refs Submitted for publication

(NASA-TM-X-65523; X-670-71-168) Avail: NTIS CSCL 03B

The OAO-2 satellite has been used to obtain far ultraviolet spectrum scans of five early-type Ia supergiants. The data reveal the presence of a distinct, broad absorption feature centered near 1739 A. This feature is unique in that it remains essentially constant in strength, breadth, and central position over the spectral type range B0Ia to A2Ia. The feature is not present in the B and A main-sequence spectra examined. It probably does not arise in the general interstellar medium because there is no correlation with reddening or with the strength of Lyman alpha. It may be formed in circumstellar clouds surrounding the supergiants. The conjecture that the feature is produced by the formaldehyde molecule is discussed. Author

N71-24960*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A LIMIT ON LINE EMISSION IN THE X-RAY BACKGROUND AT HIGH GALACTIC LATITUDES

E. A. Boldt, U. D. Desai, S. S. Holt, and P. J. Serlemitsos Apr. 1971 6 p refs Submitted for publication

(NASA-TM-X-65519; X-661-71-152) Avail: NTIS CSCL 03B

A rocket observation of the diffuse X-ray background at high galactic latitudes does not exhibit a statistically significant enhancement in the vicinity of 7 keV, implying a line intensity < or = to 0.06 + or − 0.04 (sq cm sec sr)−1. Author

N71-24962*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

COSMIC ANTIMATTER ANNIHILATION AND THE GAMMA-RAY BACKGROUND SPECTRUM

F. W. Stecker, D. L. Morgan, and J. Bredekamp Apr. 1971 13 p refs Submitted for publication

(NASA-TM-X-65517; X-641-71-150) Avail: NTIS CSCL 03B

Some initial results of a detailed calculation of the cosmological gamma-ray spectrum from matter–antimatter annihilation in the universe are presented. The similarity of the calculated spectrum with the present observations of the gamma-ray background spectrum above 1 MeV suggests evidence of the existence of antimatter on a large scale in the universe. Quantitative comparison of the calculations with the existing observations indicates the product of interacting matter and antimatter densities at present. Author

N71-24988*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

CONSIDERATIONS RELATED TO THE SUDDEN RELEASE OF A LARGE NUMBER OF COSMIC RAYS IN THE GALAXY

Carl E. Fichtel Oct. 1970 18 p refs

(NASA-TM-X-65506; X-662-70-378) Avail: NTIS CSCL 03B

The implications of a sudden release of a large number of cosmic rays as in a supernova burst are considered in the light of the conditions for containment of cosmic rays in the galactic disk. Reasons are given to show that a significant portion of the cosmic rays could be lost quickly (< 10,000 years) after a burst, and the question of whether most of the cosmic rays remaining in the galaxy ultimately escape as the result of pressure effects rather than diffusion effects is considered. In considering the question of a possible cosmic ray anisotropy, it is noted that the high degree of isotropy observed could be the result of cosmic rays existing at what is effectively their density saturated limit with no easy escape. Finally, it is pointed out that cosmic rays could be supplied to intergalactic space at a level substantially above that deduced from diffusion theory, this explains what was previously considered a possible high intergalactic electron flux. Author

N71-25025*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
EXPERIMENTAL RESULTS OF SIMULTANEOUS MEASUREMENT OF INOSPHERIC AMPLITUDE VARIATIONS OF 136 MHz and 1550 MHz SIGNALS AT THE GEOMAGNETIC EQUATOR
E. E. Crampton, Jr. (Westinghouse Elec. Corp.) and W. B. Sessions (Westinghouse Elec. Corp.) 7 Jan. 1971 35 p refs
(NASA-TM-X-65505; X-490-71-54) Avail: NTIS CSCL 03B

Data was collected on VHF and L-Band scintillation fading characteristics in the equatorial regions as part of a continuing experiment. The satellite communication system designer is provided this technical data to determine optimum spectrum bands and fade margins required for desired system reliabilities. The data retrieval technique utilized was the manual reduction of information from strip chart recordings. Automated data programs are also being developed to extract the statistical characteristics from the received data. Author

N71-25034*# National Aeronautics and Space Administration, Washington, D.C.
NUCLEAR AND SPACE RADIATION EFFECTS ON MATERIALS: SPACE VEHICLE DESIGN CRITERIA
Jun. 1970 48 p refs
(NASA-SP-8053) Avail: NTIS CSCL 18H

The results are presented of a study concerned with the identification of the significant property changes induced in structural materials by radiation from the nuclear reactor, the isotope power source, and from space, and the exposure levels at which these effects become important. Structural materials are defined as those that provide fundamental load-carrying capability or protection against the natural space environment while satisfying a functional requirement (e.g., viewing port for astronaut). Material properties affected by radiation are discussed in three categories: (1) mechanical properties including tensile strength, elasticity, elongation, impact properties, fatigue strength, hardness, shear strength, and dimensional stability; (2) thermal properties including thermal conductivity and stored energy; and (3) optical properties including emissivity, absorptance, and reflectance. Author

N71-25157# Lockheed Missiles and Space Co., Sunnyvale, Calif.
AERONOMIC CHARACTERISTICS OF THE D REGION AND ENERGETIC SPECTRA OF THE IONIZING RADIATION OF 30 OCTOBER 1969
G. Nestorov 1971 5 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 10, no. 6, 1970 p 1057–1061
(AD-719841) Avail: NTIS CSCL 4/1

A quasi-exponential model of the vertical distribution of the electron concentration in the D region is utilized to determine some fundamental parameters of this domain, and to obtain the energetic spectra of hard solar x-radiation in both the quiet periods and during the solar flares of 30 Oct. 1969. Author (GRA)

N71-25158# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
COSMIC RAY NM-64 NEUTRON MONITOR DATA, 16. MONTHLY GRAPHS, MAY–AUG. 1970
J. F. Steljes Oct. 1970 69 p
(AECL-3736) Avail: AEC Depository Libraries; Atomic Energy of Can., Ltd., Chalk River: $1.50

Uncorrected and barometer-corrected results from the cosmic-ray stations in Canada using equipment maintained by AECL are given in tabular form. Normalized graphs are also given. Correction factors for the constant rates of drift of the barometers at each of the four stations are given. Author (NSA)

N71-25198# Utah Univ., Salt Lake City. Upper Air Research Lab.
ROCKET INSTRUMENTATION FOR AURORAL MEASUREMENTS: AEROBEE 3.786 AND 3.759 Final Report, 1 Aug. 1968–30 Oct. 1970
David A. Burt and Glenn D. Allred Nov. 1970 195 p refs
(Contract F19628-69-C-0007)
(AD-719734; AFCRL-70-0658) Avail: NTIS CSCL 14/2

Two Aerobee rockets, instrumented with payloads for measuring auroral parmeters, were launched from the Churchill Research Range, Manitoba, Canada in late March 1969. Ejected nosetip payloads and main payloads were utilized to obtain simultaneous measurements at separate locations within the aurora. The instrumentation included electron and proton counters, electron density and temperature probes, X-ray counters and auroral light photometers. Details of instrumentation are presented. Author (GRA)

N71-25199# Rice Univ., Houston, Tex. Dept. of Space Science.
MEASUREMENT OF GAMMA RAY SPECTRA OF CELESTIAL LARGE ENERGY SOURCES Final Scientific Report, 1 Feb. 1969–31 Oct. 1970
R. C. Haymes 31 Jan. 1971 7 p refs
(Contract F44620-69-C-0083)
(AD-719864; AFOSR-TR-71-0548) Avail: NTIS CSCL 3/2

In order to provide clues as to the mechanisms by which some celestial sources generate huge amounts of energy, a series of balloon-altitude experiments were undertaken during 1969 and 1970. They measured gamma ray spectra, in the energy range 25 keV - 975 keV from discrete celestial sources including the Crab Nebula, Pulsars NP 0532 and PSR-0835-45, the center of our galaxy, radiogalaxies Virgo A and Centaurus A, as well as from the galactic sources Cyg XR-1, Sco XR-1, and Cen XR-4. Significant new information on these objects and their energy sources was obtained and is discussed. Author (GRA)

N71-25200 Idaho Univ., Moscow.
THE ROLE OF AN EXTRATERRESTRIAL RING CURRENT IN THE DYNAMICS OF AURORA
Chung-shan Wang (Ph.D. Thesis) 1969 94 p
Avail: Univ. Microfilms Order No. 70-10713

A change in the intensity of the ring current can provide a convenient and physically meaningful parameter for an investigation of certain dynamical features of auroras. There is evidence that the source of the auroral particles is located in the equatorial plane at a distance of at least 3.5 earth radii. A variation of the conditions in the source region is then related to the auroral phenomena by the magnetic flux conservation theorem. The equation of the magnetic lines of force is derived for the combined system of the earth's dipole and the ring current. By requiring the location of the source region to move in such a way that the field intensity at its position remains constant, an analytic expression relating the latitude and the change of the current intensity is obtained. The results are used to explain the shift of the auroral oval, and to evaluate the speeds of the north-south motion of auroral arcs and also the speeds of monochromatic mid-latitude auroral arcs of 6300A-(OI). Dissert. Abstr.

N71-25210*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
SCINTILLATION OBSERVATIONS AT ANCON AND JICAMARCA OBSERVATORIES
Jose Pomalaza, Robald F. Woodman, Gilberto Tisnado, Jaime Sandoval, and Alberto Guillen Oct. 1970 29 p refs
(NASA-TM-X-65426; X-520-70-398) Avail: NTIS CSCL 04A

The distribution of scale sizes of the diffraction pattern produced by ionospheric irregularities responsible for satellite scintillations was obtained. The sizes were derived from measurements of the time autocorrelation function of the fluctuations of the signals received from synchronous satellites and from drift velocities obtained by cross correlation methods using two spaced antennas. The sizes have been found to be of the order of 200 and not larger than

400 meters. The scale sizes of the irregularities as well as the relative amplitude of the fluctuations, for the case of lower satellites, were deduced from the measurements made with synchronous satellites using a full wave theory. As the satellite gets closer to the layer of the irregularities, the scale size of the diffraction pattern on the ground gets larger. When the distance between the satellite and the layer becomes smaller than a Fresnel distance, the r.m.s. of the amplitude scintillations is largely reduced. The preferred heights of the layer of irregularities were determined from radar measurements at Jicamarca. Author

N71-25211*# Alaska Univ., College. Geophysical Inst.
A LATITUDINAL SURVEY OF HYDROXYL AIRGLOW EMISSIONS Final Report, 1 Apr. 1969 – 31 Mar. 1970
Gerald J. Romick and Neal B. Brown 31 Mar. 1970 13 p refs
(Grant NGR-02-001-058)
(NASA-CR-118320) Avail: NTIS CSCL 03B

A multifiltered, spatially scanning photometer system was placed aboard a NASA Convair 990 aircraft and operated throughout the NASA 1969 Auroral Expedition. The instrumentation and the success of the airborne operational experiment are described, and a brief summary of the data reviewed to date is given. The primary goals of the airborne experiment were to acquire geographically widespread observational data on the emission intensities of hydroxyl (OH) and related airglow emission features, particularly at high latitudes. Author

N71-25212 Rensselaer Polytechnic Inst., Troy, N.Y.
A STUDY OF LOW ENERGY, HEAVY COSMIC RAYS USING A PLASTIC CHARGED PARTICLE DETECTOR
David Dee Peterson (Ph.D. Thesis) 1969 111 p
Avail: Univ. Microfilms Order No. 70-11329

The detector consists of thin films of Lexan polycarbonate plastic in which latent track images of penetrating charged particles can be developed to a size suitable for viewing in an optical microscope. Environmental effects on the latent track images in Lexan were studied in detail, including the effects of age, ultraviolet light, and temperature. The development of tracks by chemical etching processes is studied in detail as well as the development of a high resolution, high magnification, optical microscope system for measuring the length of etch pits. The Lexan detector was used to determine the first elemental abundance of low energy (150-250 MeV/nucleon) cosmic rays with 16 < or = to Z < or = to 30. These detailed results are compared with the more general results of various investigators and found to be in excellent agreement. Dissert. Abstr.

N71-25258*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REMOTE SENSING OF GLOBAL OZONE FROM NIMBUS 3
Cuddapah Prabhakara *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 11-14 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 03B

Nimbus 3 satellite infrared interferometer spectrometric measurements of atmospheric ozone distributions on a global basis are reported. Inverted radiance measurements provide distributions and the total amount of ozone in a vertical column so that the vertical ozone profile is characterized by a known climatological mean and unknown deviations from this mean. Solutions for these deviations are obtained by iteration schemes. Verification of the obtained solution is provided by comparison with balloon vertical ozone soundings. Results from a global ozone distribution analysis for the 22nd of April 1961 establish ozone maxima over the Northern Hemisphere in connection with low pressure systems in the Southern Hemisphere. G.G.

N71-25280*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VISCOSITY AND THE SOLAR WIND
John C. Brandt *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 105-107 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 03B

A two fluid model for the solar wind is formulated in which the proton and electron temperatures are independently determined. The model includes a viscous term in the radial momentum equation and produces a calculated electron-to-proton temperature ratio of about 7 in close agreement with observed values. G.G.

N71-25281*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE HEATING OF THE SOLAR WIND
Leonard Burlaga *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 108-110 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 03B

The relationship between the temperature and the bulk speed of the solar wind is considered in connection with Explorer 34 satellite obtained plasma data. Plots of the solar wind temperature show it proportional to the thermal speed of the solar wind versus the bulk speed. G.G.

N71-25283*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THRESHOLD LAW FOR ELECTRON IMPACT IONIZATION OF ATOMS
Aaron Temkin *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 114-118 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 03B

The ionozation threshold law for electron impact of atoms is determined by the limit of the exact wave function consisting of the following three factors: (1) the residual ion considered as a point charge with no structure; (2) the motion of the inner electron; and (3) the motion of the outer electron. G.G.

N71-25284*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OBSERVATIONS OF THE ULTRAVIOLET SOLAR FLUX VARIABILITY
Donald F. Heath *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 119-122 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 03B

Nimbus 3 observations of the ultraviolet solar flux variability are reported. Daily radiation averages of the sensor outputs cover the photosphere, the top of the photosphere, and the base of the chromosphere. Signal intensity decreases since launch of approximately a factor of 6 establish long term decay periodic with the solar rotation number, with maxima in May and November and a minimum in August. G.G.

N71-25285*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOFT SOLAR X-RAYS
Werner M. Neupert *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 123-126 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 03B

Solar X-ray spectra between 1 and 8 A are analyzed for solar flares and their physical properties. Solar spectrum components in the absence of flare activity contain a continuum that is characteristic for radiation from an optically thin plasma at a temperature of about six to eight million degrees Kelvin; superimposed on this continuum is line emission from helium-like silicon 8 ion. A solar flare changes the spectral distribution markedly; the continuum

distribution moves toward shorter wavelengths and is now characteristic of a plasma of about 27 million degrees Kelvin; multiple increased emission lines on this continuum represent very highly ionized elements up to nickel in the periodic table. Information from three lines emitted by a helium-like silicon 7 ion contains the electron density of the transition relative to the other lines and the total amount of material that is emitted at the temperature at which the ion exists; thus, the volume from which the emission erupts can be determined. G.G.

N71-25286*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ENERGETIC SOLAR X-RAYS

Kenneth J. Frost *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 127-129 (See N71-25256 13-34)

Avail: NTIS HC$6.00/MF$0.95 CSCL 03B

OSO 5 measurements of X-rays in the energy range from 14 to 250 keV are analyzed. These solar X-ray bursts constitute free electrons moving with velocities up to 0.8 c with energy loss upon subsequent slowing down. Thermal emission observed later in solar flare event is attributed to a group of electrons shot up repeatedly during the compression of the plasma. G.G.

N71-25287*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SOLAR RADIO EMISSIONS

Joseph Fainberg *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 130-133 (See N71-25256 13-34)

Avail: NTIS HC$6.00/MF$0.95 CSCL 04A

Explorer satellite radio burst data are analyzed and average exciter velocity and density profiles in the corona above the active region of 11 to 40 solar radii are obtained by considering the systematic change in drift time with solar rotation. Bursts are attributed to short packages of energetic electrons traveling outward through the corona and exciting progressively lower frequencies during propagation. G.G.

N71-25288*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RELATIVISTIC INTERPLANETARY ELECTRONS AND POSITRONS

Thomas L. Cline *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 134-139 (See N71-25256 13-34)

Avail: NTIS HC$6.00/MF$0.95 CSCL 03B

Comparison between electron and positron intensities in interplanetary regions show that, in the energy interval of 2 to 10 MeV, positrons are only a few percent as numerous as electrons so that the 2 to 10 MeV electrons indeed form a separate component in the interplanetary electron population. Time variation analyses of electron intensities establish the presence of four coherent populations: solar flare electrons, storm particles, quiet time electrons, and anomalous electron intensity variations during quiet times; the latter correlate inversely with proton intensities. G.G.

N71-25289*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GALACTIC RADIO EMISSIONS

Joseph K. Alexander, Jr. *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 140-144 (See N71-25256 13-34)

Avail: NTIS HC$6.00/MF $0.95 CSCL 04A

Radio Astronomy Explorer spectral measurements of the background radiation from the Milky Way are used to estimate the density of thermal electrons in the interstellar medium as well as the flux of interstellar cosmic rays at low energies. Plots of the specific intensity as function of frequency show a power law increase in intensity as frequency decreases, indicative of synchrotron radiation; spectrum maximum and subsequent decrease in intensity to the lowest frequency indicates absorption of the synchrotron radiation by the ionized component of the interstellar gas. Satellite measurements of the cosmic ray electron flux are appreciably higher than measurements performed on earth. G.G.

N71-25290*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

LOW ENERGY COSMIC RAYS IN THE SOLAR SYSTEM

James H. Kinsey *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 145-149 (See N71-25256 13-34)

Avail: NTIS HC$6.00/MF$0.95 CSCL 03B

IMP 4 low energy cosmic ray spectra, taken at different levels of solar activity, are studied. Data begin just after a large solar flare and present a monotonically decreasing spectrum until flare particles leave the solar system and end up at the higher energy end of the spectrum at about 80 MeV per nucleon. Final spectra for very quiet solar periods have a minimum low around 10 MeV. This indicates that the sun produces a continuous flux of energy particles during quiet times consisting of a mixture of the low energy tail of the modulated galactic spectrum and the solar spectrum. G.G.

N71-25291*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

PULSARS AND THE ORIGIN OF COSMIC RAYS

Reuven Ramaty *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 150-152 (See N71-25256 13-34)

Avail: NTIS HC$6.00/MF$0.95 CSCL 03B

Pulsar ages are estimated by assuming that they were rotating neutron stars that slowed down while dissipating their rotational energy and from measurements of period and rate of change of the period. Pulsar distances are estimated from observed dispersions of radio pulses. The basic assumption is that the pulsars are the end products of supernovae explosions and that distances and ages of cosmic rays sources are the same as those of pulsars. G.G.

N71-25292*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ULTRAHIGH ENERGY COSMIC RAYS

Floyd W. Stecker *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 153-155 (See N71-25256 13-34)

Avail: NTIS HC$6.00/MF$0.95 CSCL 03B

It is postulated that ultrahigh cosmic rays are of extragalactic origin because: (1) the total energy spectrum indicates an excess of these cosmic rays above what is expected by extrapolation from the lower energy part of the total spectrum; (2) these cosmic ray energies are so high that they cannot be contained within the magnetic field of the galaxy; and (3) the cosmic rays arrive at Earth from random directions over the whole celestial sphere and are not concentrated within the plane of the Milky Way. Lifetime calculations for cosmic ray nuclei in years versus total energy indicate that they originate in relatively local extragalactic sources of 10 to the eighth power light year distance or closer and that their constituent nuclei must be either protons or heavy nuclei such as iron. G.G.

N71-25293*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MOLECULES IN INTERSTELLAR SPACE

Louis J. Stief *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 156-161 (See

N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 03B

Based on photon flux, absorption cross sections, and knowledge of decomposition efficiencies, the lifetimes of interstellar polyatomic water, ammonia, and formaldehyde molecules are calculated and shown in tables. The lifetimes for all molecules are of the order of 1000 years; lifetimes in clouds are much higher where there is obscuration of interstellar radiation. G.G.

N71-25294*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTERSTELLAR EXTINCTION
Theodore Stecher *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 162-165 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 03B

Interstellar extinction versus wavelength plots are presented for Epsilon and Zeta Persei stars. A clearly visible bump in the center and the general shape of the curve at shorter wavelengths were attributed to interstellar grains of the same size as the wavelength of light that was being extinguished. G.G.

N71-25296*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PULSATIONS OF BLUE VARIABLE STARS
Richard B. Stothers *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 170-173 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 04A

Calculations for pulsating unstable stars that are energized by nuclear reactions are presented. Considered are a mechanism of high mass and approximately homogeneous chemical composition throughout the stellar interior and a heavier material deposition on top of the hydrogen-rich surface of the original star that triggers instability. Helium compresses the hydrogen gas and thereby shrinks the stellar radius. Such a deposition occurs if the star exists in a close binary system where the companion star evolves first, converting hydrogen into helium in its core and expanding its radius until its material overflows onto the second star. G.G.

N71-25298*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COSMIC X-RAY LINE EMISSION
Stephen S. Holt *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 178-181 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 03B

The thermal origin for the X-ray emission from the Sco X-1 source is firmly established by analyzing its spectral iron lines as a function of temperature for universal abundance and for abundances characteristic of both low and high mass supernovae shells. Statistical analysis of iron line emission data confirms the dominant thermal process. G.G.

N71-25311*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RESULTS FROM THE ATS 3 REFLECTOMETER EXPERIMENT
James B. Heaney *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 238-240 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 04A

Highly reflective specular materials having aluminum or silver surfaces either uncoated or protectively coated together with Alzak, the material that comprises the outer shell of the OAO spacecraft, were evaluated. Coating samples were thermally insulated from their surroundings and their surface reflectances relative to a standard surface were monitored periodically by ATS 3 reflectometer. Spectral variations in the degradation processes and identifications of damage causes and mechanisms were observed. Alzak data confirmed laboratory tests that proved this material to be potentially unstable; solar absorptance of unshielded samples increased from initially 15% to 26% after 2000 hours of solar exposure in orbit. Results demonstrated that dielectric film coated aluminum produces a thermal control surface comparable to white paint but of better stability. G.G.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N71-24353# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
ASTRONOMIC CIRCULAR NUMBER 582, 1970
Yu Lipskii et al Jan. 1971 14 p refs Transl. into ENGLISH from Astron. Tsirk. (Moscow), no. 582, Aug. 1970 8 p
(AD-719057; ACIC-TC-1700) Avail: NTIS CSCL 3/2

The report contains a translation of four papers by various authors dealing with astronomical topics. The subjects are: (1) The positions of centers of the base point catalogs on the moon; (2) Estimation of the accuracy heights of selenodetic catalogs; (3) On the photometric function of the moon and microstructure of the lunar surface; and (4) An unusual flare of an object in Cepheus. Author (GRA)

N71-24354# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
MODERN TECHNIQUES IN ASTRODYNAMICS: AN INTRODUCTION Final Report
Lynn E. Wolaver Dec. 1970 545 p refs
(AD-718963; ARL-70-0278) Avail: NTIS HC $6.00/MF $0.95 CSCL 3/3

The report represents lecture notes for a graduate level course in celestial mechanics which has been given at the Air Force Institute of Technology. It covers a review of the two-body problem, discusses the three-body problem, the restricted three-body problem together with regularization and stability analysis. The main portion of the report develops the Hamilton-Jacobi theory and applies it to develop Lagranges and Gauss planetary equations. The oblate earth potential is developed and the secular equation solved. Effect of small thrust, drag, lunar-solar gravitational and solar radiation perturbations are developed mathematically and the effects discussed. Von Zeipels method for the solution of nonlinear equations is developed and used to solve Duffings equation as an example. Special perturbations are discussed along with errors due to numerical integration and Enckes method is used to obtain approximate analytical results for the motion of stationary satellites. Finally a complete discussion of coordinate systems, time scale and astronomical constants are given. The report ends with a detailed discussion of the shape of the earth. Two appendices briefly cover numerical integration and a review of Lagrangian mechanics. Author (GRA)

N71-24355*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A BRIEF SURVEY OF THE OUTER PLANETS JUPITER, SATURN, URANUS, NEPTUNE, PLUTO, AND THEIR SATELLITES
R. L. Newburn, Jr. and S. Gulkis 15 Apr. 1971 69 p refs revised Supersedes JPL-TM-33-424; N69-21283
(Contract NAS7-100)
NASA-CR-118180; JPL-TR-32-1529; JPL-TM-33-424) Avail: NTIS CSCL 03C

The best available numerical values are given for physical parameters, including orbital and body properties, atmospheric composition and structure, and photometric parameters. The more acceptable current theories of these bodies are outlined with thorough referencing offering access to the details. The survey attempts to be complete through 15 February 1971. Author

N71-24356*# Texas Univ., Dallas. Geosciences Div.
EVIDENCE FOR AN ANCIENT LUNAR MAGNETIC FIELD. INVESTIGATION OF THE MAXIMUM MAGNETIC FIELD EVER PRESENT ON THE MOON Final Report
Charles E. Helsley Apr. 1971 18 p refs *Its* Contrib. No. 174
(Contract NAS9-8767)
(NASA-CR-114972) Avail: NTIS CSCL 03C

Magnetic studies of samples 12002 and 12022 show that these samples contain a weak remanent magnetic moment. Progressive thermal demagnetization experiments suggest that these moments are stable and were not acquired as a result of exposure to the earth's magnetic field. The primary carrier of remanence is native iron. In addition, two spinel phases (chromite and ulvospinel) and troilite are also present in these samples. Progressive thermal demagnetization experiments also suggest that the remanent magnetization of these rocks was acquired on the moon in the presence of an applied field of up to 5000 gammas, provided that the initial magnetization was acquired by an ordinary partial thermoremanent process. This would imply that the moon had a weak magnetic field 3.5 to 4.0 aeons ago and suggests that small conducting fluid core may have been present at that time. Author

N71-24358*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif. Space Sciences Dept.
LUMINESCENCE OF APOLLO 11 AND 12 LUNAR SAMPLES
Norman N. Greenman and H. Gerald Gross [1970] 25 p refs Submitted for publication
(Contract NAS9-7966)
(NASA-CR-114970) Avail: NTIS CSCL 03C

Luminescence measurements were made of Apollo 11 and 12 samples with far, middle, and near UV, X-rays, and protons. Efficiencies were found to be low, of the order of 1 millionth or less, for all irradiations. These cannot account for the astronomical observations of luminescence on the moon, at least not in the Apollo 11 and 12 landing areas and at least to the extent that the samples are representative there were no sialic rocks, as 12013, among the samples). In general, the efficiencies agree well with those for terrestrial rocks in which efficiency decreases with increasing basic character. There is no evidence from measurements of both interior and exterior specimens that micrometeorite impact, space radiation, and other mechanisms operating at the lunar surface have affected the luminescence character of the rocks. Such effects are too small to be seen in the present series measurements because of low luminescence efficiency and consequent weak signal. Author

N71-24359*# International Business Machines Corp., Houston, Tex. Trajectory Determination Dept.
EXPONENTIAL DOWNWEIGHTING OF PAST DATA IN A SINGLE STAGE, WEIGHTED-LEAST-SQUARES TRAJECTORY PROCESSOR
Robert G. Rich 3 Nov. 1970 9 p
(Contract NAS9-996)
(NASA-CR-114979; H70-0031-R; Rept-70-5667)Avail: NTIS CSCL 22C

Long-duration missions are being planned with a new requirement for storing radar tracking measurements and processing them much less frequently. For example, a single-stage filter might be used at 24-hour intervals to process, in each case, the past 15 hours of stored data. The accuracy of each estimate, of course, would depend on the magnitude of model errors along the data arc. This is the motivation for seeking a way of adjusting the single stage, weighted least squares filter to compensate for model errors. An empirical method is presented which does this by allowing exponential downweighting of past data at selected rates along respective axes of a selected coordinate system. Author

N71-24360# Royal Aircraft Establishment, Farnborough (England).
THE CHANGE IN SATELLITE ORBITAL INCLINATION CAUSED BY A ROTATING ATMOSPHERE WITH DAY-TO-NIGHT DENSITY VARIATION
D. G. King-Hele and Doreen M. C. Walker Nov. 1970 24 p refs
(RAE-TR-70208) Copyright. Avail: NTIS

The mathematical theory specifying the change Delta i in a satellite's orbital inclination due to atmospheric rotation, in terms of the decrease in orbital period Delta T has been extended to an atmosphere with sinusoidal variation of density between day and night. It is found that with certain special sets of values for the orbital parameters, the day-to-night variation in the earth's atmosphere can alter the equation for Delta i/Delta T by as much as 25%, though only for a few days. Appreciable changes in Delta i/Delta T persisting for several months can only occur for certain resonant orbits: the maximum change is than about 8%. Near-resonance is very unlikely, but the resonance conditions are derived so that dangerous orbits can be recognized and avoided. Author (ESRO)

N71-24555*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
[LUNAR SURFACE MATERIAL ANALYSES] Final Report
Anthony L. Turkevich 31 Mar. 1971 65 p refs
(Contract NAS9-7883)
(NASA-CR-114976) Avail: NTIS CSCL 03C

CONTENTS:

1. COMPARISON OF THE ANALYTICAL RESULTS FROM THE SURVEYOR, APOLLO, AND LUNA MISSIONS 19 p refs (See N71-24559 13-30)

2. ACTIVATION ANALYSIS DETERMINATION OF URANIUM AND Pb 204 IN APOLLO 11 LUNAR FINES A. Turkevich, G. W. Reed, Jr., H. R. Heydegger, and J. Collister 28 p refs (See N71-24560 13-30)

3. EXAMINATION OF RETURNED SURVEYOR 3 CAMERA VISOR FOR ALPHA RADIOACTIVITY T. E. Economou and A. L. Turkevich 16 p refs (See N71-24561 13-24)

N71-24559*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
COMPARISON OF THE ANALYTICAL RESULTS FROM THE SURVEYOR, APOLLO, AND LUNA MISSIONS
Anthony L. Turkevich *In its* [Lunar Surface Mater. Analyses] 31 Mar. 1971 19 p refs Presented at the Apollo 12 Lunar Sci., Conf., Houston, Tex., 11-14 Jan. 1971 Submitted for publication
(See N71-24555 13-30)
Avail: NTIS CSCL 03C

The principal chemical element composition and inferred mineralogy of the powdered lunar surface material at five mare and one terra sites on the moon are compared. The mare compositions are all similar to one another and comparable to that of terrestrial ocean ridge basalts except in having higher titanium and much lower sodium contents than the latter. These analyses suggest that most, if not all, lunar maria have this chemical composition and are derived from rocks with an average density of 3.19 g/cu cm. Mare Tranquillitatis differs from the other three maria in having twice the titanium content of the others. The chemical composition of the single highland site studied (Surveyor 7) is distinctly different from that of any of the maria in having much lower amounts of titanium and iron and larger amounts of aluminum and calcium. The

inferred mineralogy is 45 mole percent high anorthite plagioclase and the parent rocks have an estimated density of 2.94 g/cu cm. Author

N71-24580*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
ACTIVATION ANALYSIS DETERMINATION OF URANIUM AND Pb 204 IN APOLLO 11 LUNAR FINES
Anthony Turkevich, George W. Reed, Jr., H. Roland Heydegger, and J. Collister *In its* [Lunar Surface Mater. Analyses] 31 Mar. 1971 28 p refs Presented at the Apollo 12 Lunar Sci. Conf., Houston, Tex., 11–14 Jan. 1971 Submitted for publication (See N71-24558 13-30)
Avail: NTIS CSCL 03C

The U-238 abundance in the Apollo 11 type D material was determined via the U-238(n,2n)U-237 reaction with a resultant mean value from four replicates of 0.54 + or −0.02 ppm. Neutron activation analysis was also applied to the determination of the Pb-204(n,2n,)Pb-203 reaction. Three samples gave results varying from 2.2 to 7.1 ppb. In addition, some data were obtained on the bismuth and thallium contents of the sample. The Pb-204 and Pb-208 contents of two chondritic meteorites were also determined. Author

N71-24928 Wisconsin Univ., Madison.
A PHOTOELECTRIC STUDY OF BE STARS
Joseph Calhoun Boone (Ph.D. Thesis) 1970 92 p
Avail: Univ. Microfilms Order No. 70-8270

Balmer jumps and equivalent widths of the first three Balmer lines were measured for twenty-seven bright Be stars and twenty-nine normal B stars. By comparing the observed Balmer jumps of normal B stars with the Balmer jumps of available stellar models, an effective temperature scale for stars from B0 to B7 was determined. The emission in the Balmer continuum and the Balmer lines was calculated by comparing the Be stars with stellar models and normal B stars. The H-alpha, H-beta ratio shows a smaller variation from star to star than other observers have found, suggesting that Be envelopes may be a rather homogeneous group of objects. Further, the average value of this ratio is close to 2.2, lower than earlier determinations. Relative to the Balmer continuum emission, the emission in the first three Balmer lines is much less than would be expected if Be star envelopes were comparable to planetary nebula models. Dissert. Abstr.

N71-24941 Indiana Univ., Bloomington.
CALCIUM K LINE FORMATION IN A NONHOMOGENOUS SOLAR ATMOSPHERE
Herbert Alonzo Beebe (Ph.D. Thesis) 1969 122 p
Avail: Univ. Microfilms Order No. 70-12400

In the solar spectrum emission features are observed in the cores of the resonance lines of singly ionized calcium. A theoretical study was made of the formation of these intensity reversals in the solar chromosphere, applying a detailed theory of line formation and, by comparison between theoretical and observational results, an evaluation of solar atmospheric models. The application of a two component chromospheric model allows the theoretical prediction of details revealed observationally by spectrograms of high spectral and spatial resolution. Further criteria for evaluation of the components are established by the absolute intensities in both bright and dark regions as a function of wavelength in the Ca II K core. A 4600 K atmospheric temperature minimum is found to require, in the cooler component, turbulent velocities of the order of 20 km/sec to produce a satisfactory match of calculated and observational average profiles. Dissert. Abstr.

N71-24944*+ Pennsylvania State Univ., University Park. Materials Research Lab.
QUANTITATIVE MICRO-LUMINESCENCE ANALYSIS OF LUNAR SURFACE MATERIAL
Rustum Roy 1 Mar. 1971 53 p refs Presented at the Apollo 12 Lunar Sci. Conf., Jan. 1971 Submitted for publication
(Grants NGR-39-009-(152); NGL-39-009-015)
(NASA-CR-114966) Avail: NTIS CSCL 03C

Three Apollo 12 Lunar Science Conference papers are presented to illustrate the results of lunar sample studies. The papers are: (1) lunar glass 1: densification and relaxation studies, (2) lunar glass 2: structure analysis by optical Raman and X-ray emission spectroscopy and electrical measurements, and (3) particle size and shape distribution of lunar fines. E.C.

N71-24950# Lockheed Missiles and Space Co., Sunnyvale, Calif.
LANDING TRACKS OF ORBITAL VEHICLE
I. Osokin [1971] 7 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 12, 1970 p 36–38
(AD-719849) Avail: NTIS CSCL 22/3

The report describes processes used to determine the flight paths, descent trajectories and landing sites of satellites. GRA

N71-24991# European Space Research Organization, Paris (France).
PLANETARY SPACE MISSIONS. VOLUME 1: BASIC DATA ON PLANETS AND SATELLITES [MISSIONS SPATIALES VERS LES PLANETES. VOL. 1: DONNEES FONDAMENTALES SUR LES PLANETES ET LEURS SATELLITES]
Nov. 1970 55 p refs Partly in FRENCH and partly in ENGLISH Proc. of the 7th ESRO Summer School, Interlaken, Switz., 1969
(ESRO-SP-53) Avail: NTIS

CONTENTS:

1. DETERMINATION OF MASSES AND MOMENTS OF INERTIA OF PLANETS AND SATELLITES A. Bec (Bureau des Longitudes, Paris, France) p 1–11 refs (See N71-24992 13-30)

2. DIAMETERS AND FLATTENING OF PLANETS A. Dollfus (Observatoire de Paris, Meudon, France) p 13–27 (See N71-24993 13-30)

3. ON THE EVOLUTION OF THE ANGULAR VELOCITY OF BODIES IN THE SOLAR SYSTEM G. Colombo (Padua Univ., Italy) p 29–36 (See N71-24994 13-30)

4. SOME ASPECTS OF THE PROBLEM OF ASTEROIDS S. Arend (Belg. Roy. Obs., UCCLE.) p 37–48 (See N71-24995 13-30)

N71-24992# Bureau des Longitudes, Paris (France).
DETERMINATION OF MASSES AND MOMENTS OF INERTIA OF PLANETS AND SATELLITES [DETERMINATION DES MASSES ET MOMENTS D'INERTIE DES PLANETES ET DES SATELLITES]
A. Bec *In* ESRO Planetary Space Missions. Vol. 1: Basic Data on Planets and Satellites Nov. 1970 p 1–11 refs In FRENCH (See N71-24991 13-30)
Avail: NTIS

The mathematical procedure used to derive masses of moments of inertia of planets and their satellites from planetary position observations are explained. ESRO

N71-24993# Observatoire de Paris (France).
DIAMETERS AND FLATTENING OF PLANETS [DIAMETRES ET APLATISSEMENT DES PLANETES]
Audouin Dollfus *In* ESRO Planetary Space Missions. Vol. 1: Basic Data on Planets and Satellites Nov. 1970 p 13–27 In FRENCH (See N71-24991 13-30)
Avail: NTIS

A review is given of the experimental methods used to determine the diameters and polar flattenings of planets in the solar system. ESRO

N71-24894# Padua Univ. (Italy).
ON THE EVOLUTION OF THE ANGULAR VELOCITY OF BODIES IN THE SOLAR SYSTEM
Giuseppe Colombo *In* ESRO Planetary Space Missions. Vol. 1: Basic Data on Planets and Satellites Nov. 1970 p 28–36 (See N71-24991 13-30)
Avail: NTIS

Current theories trying to account for the present values, and past history, of the angular velocity and angular momentum of the chief isolated bodies of the solar system have not met with equal success in all cases. If Mercury, the moon and several of Jupiter's and Saturn's satellites do not present major problems, the behavior of Venus and Mars is much more difficult to explain. In addition to the classical notions of celestial mechanics, two effects have to be introduced: the tidal torque, which pulls the spin axis into the orbital plane, and the core-mantle interaction which may erect the spin axis toward the normal to the orbital plane. Two simple models have been chosen to illustrate these effects: that of a comet, displaying the atmosphere-nucleus interaction, and that of a planet with core-mantle coupling. Author (ESRO)

N71-24895# Belgian Royal Observatory, Uccle.
SOME ASPECTS OF THE PROBLEM OF ASTEROIDS [QUELQUES ASPECTS DU PROBLEME DES ASTERIODES]
S. Arend *In* ESRO Planetary Space Missions. Vol. 1: Basic Data on Planets and Satellites Nov. 1970 p 37–48 In FRENCH (See N71-24991 13-30)
Avail: NTIS

Chief problems encountered in the study of solar system minor planets are reviewed. Author (ESRO)

N71-25042*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APOLLO 11 MISSION REPORT
Washington 1970 228 p refs
(NASA-SP-238) Avail: NTIS CSCL 22C

Details are presented on the flight phases, trajectories, communications, performance of the modules and extravehicular mobility unit, lunar surface scientific experiments, biomedical evaluation, ground support, and launch vehicle summary. Among the conclusions are the following: Preflight training was effective, and guidance, navigation, and control techniques were good. The extravehicular mobility units were adequately designed. The two-man prelaunch checkout and countdown for LM ascent were well planned and executed. The time-line activities of the lunar landing mission were within the crew's capability. The quarantine operation was accomplished successfully, and no extraterrestrial microorganisms were recovered. The hardware problems did not unduly hamper the crew or compromise safety. The Mission Control Center and the Manned Space Flight Network proved adequate for controlling and monitoring the flight. N.E.N.

N71-25043*# Analytical Mechanics Associates, Inc., Seabrook, Md.
SOLAR ELECTRIC PERFORMANCE DATA FOR EXTRA ECLIPTIC AND SOLAR PROBES AND CERES, D'ARREST, AND ENCKE RENDEZVOUS MISSIONS
J. L. Horsewood, F. I. Mann, and P. F. Flanagan Dec. 1970 314 p refs (Contract NAS5-20128)
(NASA-CR-118312; Rept-70-47) Avail: NTIS HC $6.00/MF $0.95 CSCL 22A

A collection of trajectory and spacecraft data are presented for relatively difficult unmanned missions to selected solar system targets using optimally and suboptimally powered solar electric propulsion. Data are given for .1 and .05 AU indirect solar probes, for 45 deg and 60 deg unit-sphere extra-ecliptic missions, and for rendezvous missions to the asteroid Ceres and the comets D'Arrest and Encke. Ceres, D'Arrest, and Encke are assumed to move in fixed elliptical orbits in three dimensions. Fully optimized trajectory data are given for all missions, using the two launch vehicles Titan 3 D(1205)/Centaur and Titan 3 B(core)/Centaur. Trajectory data assuming suboptimally powered spacecraft are given for solar probe and extra-ecliptic missions. A constant jet exhaust speed solar electric propulsion system having a specific mass of 25, 30, or 35 kg/kW is optimized to yield maximum net spacecraft mass. The departure hyperbolic excess speed is optimized, and the rendezvous missions are accomplished by means of low thrust propulsion. Author

N71-25068 Indiana Univ., Bloomington.
CONSTRUCTION OF A THEORETICAL ATMOSPHERE AND DETERMINATION OF METAL ABUNDANCES FOR R CYG
Reta Fay Jenkins Beebe (Ph.D. Thesis) 1969 143 p
Avail: Univ. Microfilms Order No. 70-12948

Flux-corrected radiative atmospheres were constructed which include contributions to the opacity by water and CO as straight mean absorption coefficients. The abundances of carbon and oxygen were adjusted to give a flux distribution which is in agreement with results from broad-band photometry of S-stars. Using these models, theoretical spectra for intervals ten angstroms in width were constructed. Abundances were adjusted so that the theoretical spectra agree with the observed spectrum of R Cyg in the 5400 to 6000 angstrom region. The requirement of a low number density of TiO was satisfied by using a carbon-to-oxygen ratio of .96 and a reduced abundance of titanium relative to the solar value. Dissert. Abstr.

N71-25087 California Inst. of Tech., Pasadena.
THE ATMOSPHERES OF THE SUPERGIANTS
Patrick Stewart Osmer (Ph.D. Thesis) 1970 130 p
Avail: Univ. Microfilms Order No. 70-12493

Coude spectra of 26 supergiants of spectral types F2-G5 were obtained and spectrophotometric observations of four which occurred in clusters were made. A photoelectric system for measuring the O I 7774 line was established, and the line strength was determined in 59 AO-G3 stars of luminosity classes Ia-V. The applicability of model atmospheres to the F supergiants was checked by using the spectrophotometric observations. The derived temperatures were reasonable, but the gravities of the Ia stars were a factor of 5 less than expected from stellar interiors calculations. The difference was less for the Ib stars. It was shown that pulsational effects did not account for the discrepancy. Consideration of how the turbulent motions could affect the pressure equilibrium in the atmosphere indicated that the observed velocities were large enough to reduce the gas pressure and cause the observed low gravities. The models also indicated that a decrease in the continuous absorption combined with the observed microturbulence accounted for the increase in the oxygen line strength with luminosity. Dissert. Abstr.

N71-25070*# National Aeronautics and Space Administration. Washington, D.C.
METEOROID DAMAGE ASSESSMENT: SPACE VEHICLE DESIGN CRITERIA
May 1970 60 p refs
(NASA-SP-8042) Avail: NTIS CSCL 03B

Procedures for determining meteoroid damage to and providing protection for the structure of space vehicles are discussed. Subsystems such as nonintegral tanks and thermal protection systems for entry vehicles are considered, as well as the principal load-carrying elements. Author

N71-25113 California Univ., San Diego.
SOME PROBLEMS IN THE THEORY OF RADIO SOURCES AND PLANETARY NEBULAE
Charles Malcolm Walmsley (Ph.D. Thesis) 1969 156 p
Avail: Univ. Microfilms Order No. 70-11948

Current theories to explain the variable centimeter radio sources are discussed. Sample spectra are calculated for a few situations which might be expected to arise. In particular, the effects of synchrotron self absorption and Compton scattering in young compact sources are calculated in detail. The general conclusion is that relativistic electrons are being injected into these sources long after the initial outburst. Also, it is likely that it will be possible to observe Compton scattered radio photons in the optical and X-ray range. In the section on planetary nebulae, the results are given of a calculation on Lyman line transfer. It is concluded that high Lyman lines in planetaries may be observable. Emergent fluxes and profiles are calculated for Lyman alpha-10 as well as the run of line intensity with radius. Dissert. Abstr.

N71-25152*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DESIGN AND IMPLEMENTATION OF MODELS FOR THE DOUBLE PRECISION TRAJECTORY PROGRAM (DPTRAJ)
Gerd W. Spier 15 Apr. 1971 149 p refs
(Contract NAS 7-100)
(NASA-CR-117958; JPL-TM-33-451) Avail: NTIS CSCL 22C

The models used at present are described, with emphasis on the development of the equations. The differential equations of motion of the spacecraft are integrated numerically in a rectangular coordinate system to give the spacecraft ephemeris with ephemeris time as the variable. Upon integration, the following information is available: a spacecraft ephemeris, planetary and lunar ephemerides, a list of events involving the spacecraft, and a list of epochs. Information regarding the spacecraft and the solar system at the time of occurrence of these event and epochs is subdivided into the body group, the conic group, and the angle group. Author

N71-25153*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DEEP SPACE NETWORK SUPPORT OF THE MANNED SPACE FLIGHT NETWORK FOR APOLLO, VOLUME 2 Technical Memorandum, 1969-1970
F. M. Flanagan, R. B. Hartley, and N. A. Renzetti 1 May 1971 84 p refs
(Contract NAS7-100)
(NASA-CR-118325; JPL-TM-33-452-Vol-2) Avail: NTIS CSCL 22A

The DSN activities in support of Apollo 9 through 13 missions are summarized. The narrative includes a mission description, the NASA support requirements placed on the DSN, and a comprehensive account of the support activities provided by each committed DSN deep space communication station. Associated equipment and activities of the three elements of the DSN (i.e., the Deep Space Instrumentation Facility, the Space Flight Operations Facility, and the Ground Communications Facility) in meeting the radio-metric and telemetry demands of the missions are documented. Recent scientific and engineering developments and plans are also discussed which will have a direct effect on future DSN Apollo support plans. Author

N71-25274*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SHOCK METAMORPHISM OF BASALT AND THE LUNAR SAMPLES
Nicholas M. Short *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 76-80 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 03C

The composition of basalt from a crater produced by nuclear explosion is compared to lunar rock samples from lunar depressions. Shock damage effects in the basalts differed from those found in shocked Moon rocks mainly by the absence of recrystallization effects and their nonfragmentary character. G.G.

N71-25275*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LUNAR MASCONS DETERMINED FROM THREE APOLLO MISSIONS
James P. Murphy *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 81-84 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 03C

Tracking data from manned lunar missions established the effects of mass concentrations in range rate residuals during lunar orbits. Observed Apollo 9 spacecraft accelerations toward the lunar surface at greater rates were analyzed by applying Newton's law. A mass concentration of 3.8 times 10 to the 20th power g, or 5 millionths of the mass of the moon at a depth of 100 km was established for the mascon in the Sinus Aestuum region on the lunar surface. Mascon data from later Apollo flights were added and used to form an Apollo 12 operational gravity model. G.G.

N71-25276*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A DIFFERENT LOOK AT MASCONS
Donald S. Woolston *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 85-90 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 03C

The responses of various orbit determination schemes to errors intentionally introduced into the earth's force field are studied by reference orbit simulations. Several error sources unrelated to mascons are introduced into orbit calculations and it is shown that they produce residual patterns similar to those from which mascons are deduced. G.G.

N71-25277*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE STRUCTURE OF THE MARTIAN ATMOSPHERE FROM MARINERS 6 AND 7
S. Ichtiaque Rasool *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 91-93 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 03C

Mariner 6 and 7 Mars S-band occultation signals are evaluated for phase changes caused by atmospheric refractions in order to derive temperature and pressure of the Martian atmosphere. Temperature profiles as function of pressure are computed for 100% CO_2 at four planetary locations. Comparison of atmospheric surface pressures established an elevation of about 6 or 7 km 58 deg south latitude. A temperature difference of about 100 K in the middle atmosphere between daytime and nighttime values is attributed to high opacity of the CO_2 atmosphere or the presence of dust that absorbs infrared and solar radiation. Nighttime polar cap temperatures close to the condensation temperature of CO_2 indicate the presence of dry ice. G.G.

N71-25278*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE CONTRIBUTION OF ATMOSPHERIC AEROSOLS TO THE MARTIAN OPPOSITION EFFECT
Jaylee M. Mead *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 94-99 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 03C

A nonlinear surge of brightness as Mars approaches a phase angle of zero degrees is much more pronounced in the blue than in the red region. Mie light scattering calculations on the contribution of atmospheric aerosols to the Mars opposition effect for a number of substances which have been identified as Martian atmospheric components did not produce an opposition effect. However, calculations on refractive aerosol indices from 1.55 to 2.0

show a definite increase in brightness at small phase angles with little or no enhancement at larger phase angles. Introduction of a surface brightness function to the infrared observations together with submicron aerosols having a refractive index of 1.75 produced a calculated phase curve in reasonable agreement with observed values. G.G.

N71-25279*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PHYSICAL PROPERTIES OF THE VENUS IONOSPHERE
Jay R. Herman *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 100–104 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 03C

Mariner 5 ionospheric cross section data at a point about 45 deg from the subsolar wind point were used to form a physical Venus ionosphere model. The equations of heat transport for electron, ion, and neutral gases were solved along with momentum and chemical equations for charged particle densities. Results show that the key parameters of the daytime Venus ionosphere are: (1) thermal structure; (2) ion composition; and (3) magnitude of the horizontal magnetic field. G.G.

N71-25295*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OXYGEN PRESSURE DURING THE FORMATION OF METEORITES
Louis S. Walter *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 166–169 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 03B

Oxygen pressure as a function of temperature in meteorite formation is studied on equilibrated stony meteorites. Data at 800 C for four different meteorites fluctuate between 10 to the 20th power to approximately 10 to the 22nd power of oxygen pressure; the enstatic meteorites exhibited an oxygen pressure of about 10 to the 24th power. These hydrogen to oxygen ratios are about 50 times higher than previously assumed for primary solar nebulae. G.G.

N71-25297*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A HIGHLY EVOLVED STAR: SIGMA ORIONIS E
Daniel A. Klinglesmith *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 174–177 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 04A

The helium star Sigma Orionis E in the Orion constellation is characterized by strong helium and weak hydrogen absorption lines. Measured equivalent widths of 39 absorption lines are compared with theoretical computed values from flux corrected model atmospheres with variations in effective temperatures, surface gravities, and chemical compositions. The resulting best fitting atmosphere for the star consists of a temperature around 23,500 K, a log of surface gravity of 4.05, a chemical composition by hydrogen mass of 28 percent, and of 67 percent helium. It is confirmed that Sigma Orionis E burned its hydrogen and converted it into helium and that it is only a 10 solar mass star. G.G.

N71-25299*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THEORY OF PULSARS
Hong-Yee Chiu *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 182–188 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 03B

A broadband stellar laser mechanism is stipulated as pulsar surface emitting at the maximum rate allowed by electrodynamic theory. This laser is excited by an electric field produced through the rotation of the neutron star's magnetic field. The emerged radiation is guided by magnetic field lines into very sharply defined beams that produce a pulsing effect as they rotate and pass by the visual field. This model explains a number of observed phenomena such as the polarization changes. G.G.

N71-25300*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STUDIES OF ORBIT LIFETIMES OF VENUS AND MARS ORBITERS
Robert E. Coady *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 193–196 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 03B

Orbital lifetimes for conducting the required scientific experiments during Venus and Mars orbiter missions are very sensitive to perturbations since their pericenters are just above the atmospheres of the planets. Mission planning to offset satellite deviations from two-body motions centers on: (1) development of techniques for predicting the lifetimes of planetary satellite orbits (Venus and Mars); (2) evaluation of major perturbation effects acting on the spacecraft orbit – the oblateness of the planet, third body perturbations, and atmospheric drag; and (3) recommendations of hardware developments for preflight mission planning and in-flight determination of orbit insertion conditions. G.G.

N71-25301*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GENERALIZED MULTISTEP METHOD AS APPLIED TO TRAJECTORY DETERMINATION
Carmelo E. Velez *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 197–201 refs (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 03C

Numerical integration methods are developed that reduce the required computer time in present orbit determination and parameter estimation systems. Generalized multistep formulas of high accuracy use equally spaced backpoints to integrate differential equations at reasonable error propagation; a 5-point formula is equivalent to an 11th order method, so that the lower region of step sizes results in a dominance of round-off error. These highly accurate formulas lead to more efficient computer algorithms by allowing large step sizes while maintaining the accuracy of smaller step size methods. Results of some preliminary accuracy comparisons between the new generalized methods and the classical Gauss-Jackson method confirm the stability of the new method. G.G.

N71-25302*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TESTS AND COMPARISONS OF DIFFERENT SETS OF GEOPOTENTIAL COEFFICIENTS FOR ORBIT DETERMINATION AND PREDICTION
James G. Marsh *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 202–204 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 03C

Orbit determinations for the GEOS 1 and GEOS 2 satellites are presented where different sets of geopotential coefficients are used to keep perturbations due to air drag and solar radiation pressure minimized. Orbits over approximately 6 days are computed by using optical solutions and eight unclassified sets of gravity coefficients. Typical results for a 6 day arc of GEOS 2 data are shown; agreement between computations and observations was significantly improved by adding modified 13th-order resonant coefficients. G.G.

N71-25303*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

NEW RESULTS IN RESONANT SATELLITE GEODESY
Carl A. Wagner *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 205–207 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 03B

The incorporation of deeply resonant satellite data into the solution for the geopotential orbit determinations of high altitude synchronous communications satellites is reported. Constraint data from deeply resonant satellites provide considerable geopotential improvements as is shown in an example calculation for the orbit of Intelsat 2F-8 over a one year period. The use of nonresonant and resonant gravity fields reduced position error by an order of over one magnitude. G.G.

N71-25304*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LUNAR GRAVITY FIELDS DETERMINED FROM APOLLO 8 TRACKING DATA
Theodore L. Felsentreger *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 208–210 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 03B

Doppler data from the last eight Apollo 8 revolutions of the moon are used to derive a number of lunar field gravity models through degree and order 6 in spherical harmonics in an attempt to form a lunar gravity model for subsequent Apollo orbit predictions. Comparison of one derived gravity model with that adopted for the Apollo 10 and 11 missions established a smaller range-rate residual pattern for new developed orbit computation method. G.G.

N71-25305*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LOFT TEST MODEL
William D. Hibbard *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 211–215 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 03C

Several scale models of a low frequency radio telescope with a spinning paraboloidal antenna about one mile in diameter were tested on a pattern range in order to investigate their radio frequency design and the antenna feed. The dynamic modes of the 5-m-, 50-m-, and 15-m-diameter loft models were identified and a preliminary study on instrumentation requirements for a 50-m flight model was completed. Successful testing of a 5-m-diameter LOFT model in a dynamic test chamber established its capability of stowing and deploying a complete paraboloidal net in a vacuum environment. G.G.

N71-25328*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IMAGE RECORDING DEVICES FOR ASTRONOMY
Kenneth L. Hallam *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 299–301 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 03A

The development and production of a high resolution UV image converter, suitable for either direct photographic recording or for coupling to a television pickup, are described where the optical image is focused onto the UV photocathode transparent down to 1050 A. Photoelectrons emitted by the cathode are accelerated by a 20-kV electric field through a 200-G solenoidal magnetic field to the anode at the other end of the converter tube where they are focused onto an aluminized phosphor for reproduction in blue light image of the original UV scene. The performance characteristics of this magnetically focused UV image converter are shown in table form. G.G.

N71-25436 Wisconsin Univ., Madison.
THE DIFFUSION OF LYMAN alpha THROUGH THE GALAXY
Thomas Frederick Adams (Ph.D. Thesis) 1970 73 p
Avail: Univ. Microfilms Order No. 70-8255

A method is presented for studying the transfer of resonance-line radiation in media of extremely large optical thickness. To start each solution to the transfer problem, an initial guess is made at the frequency- and space-dependence of the source function. An iteration procedure is used to solve the equation of transfer. The equation of radiative equilibrium is used to determine the distribution of sources necessary to support this radiation field. Photon destruction mechanisms can be included in the transfer problem through the equation of radiative equilibrium. Different initial guesses are tried until one is found that leads to a radiation field whose distribution of sources approximates the desired distribution. Dissert. Abstr.

N71-25465# Academy of Sciences (USSR), Moscow.
COSMIC DATA: MONTHLY REVIEW, NO. 2, FEBRUARY 1970
Feb. 1970 51 p In RUSSIAN; ENGLISH summary
Avail: NTIS

The results are tabulated of observations on geophysical phenomena concerning electric and magnetic states of the upper atmosphere (geomagnetic variations, ionosphere, cosmic rays and earth currents). Solar activity data are included. Author

N71-25476# Academy of Sciences (USSR), Moscow.
COSMIC DATA: MONTHLY REVIEW, NO. 1, JANUARY 1970
Jan. 1970 64 p refs In RUSSIAN; ENGLISH summary
Avail: NTIS

The results are tabulated of observations on geophysical phenomena concerning electric and magnetic states of the upper atmosphere (geomagnetic variations, ionosphere, cosmic rays and earth current). Solar activity data are included. Author

N71-25487*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE INFLUENCE OF THE GREAT INEQUALITY ON THE SECULAR DISTURBING FUNCTION OF THE PLANETARY SYSTEM
Peter Musen Washington May 1971 27 p refs
(NASA-TN-D-6279; G-1022) Avail: NTIS CSCL 03B

This paper derives the contribution F2 by the great inequality to the secular disturbing function of the principal planets. Andoyer's expansion of the planetary disturbing function and von Zeipel's method of eliminating the periodic terms is employed; thereby, the corrected secular disturbing function for the planetary system is derived. An earlier solution suggested by Hill is based on Leverrier's equations for the variation of elements of Jupiter and Saturn and on the semi-empirical adjustment of the coefficients in the secular disturbing function. Nowadays there are several modern methods of eliminating periodic terms from the Hamiltonian and deriving a purely secular disturbing function. Von Zeipel's method is especially suitable. The conclusion is drawn that the canonicity of the equations for the secular variation of the heliocentric elements can be preserved if there be retained, in the secular disturbing function, terms only of the second and fourth order relative to the eccentricity and inclinations. Author

N71-25498*# Texas Univ., Austin. Radio Astronomy Observatory.
THE UTRAO PERIODOGRAM SURVEY: PRELIMINARY REPORT FOR PERIODS GREATER THAN 9h 06m 08s
F. A. Bozyan 25 Feb. 1971 16 p refs
(Grant NGL-44-012-055)
(NASA-CR-118335; Rept-29) Avail: NTIS CSCL 04B

Interest in the periodic nature of Jupiter radio bursts has revealed the strong correlation of Jovian activity with the position of both the satellite Io and the central meridian longitude of Jupiter. To investigate the presence of further correlates, we have computed a complete survey of the independent periods greater than 9 hours 06 minutes 08 seconds. This survey consists of a periodogram investigation of 131 072 trial periods. One complexity of periodogram analysis of Jupiter data is the non uniform rotation of the Jovian longitude system. The jovocentric right ascension of the earth introduces a considerable phase modulation into the occurrence statistics collected by a terrestrial observer. While the removal of this modulation is not difficult, the process will destroy any purely time periodic component of the occurrence statistics, which is the price of revealing any correlate within the Jovian rotation frame. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N71-24380# Societe Europeenne d'Etude et d'Investigation de Systemes Spatiaux, Courbevoie (France). Direction Technique.

A STUDY OF THE THERMAL BEHAVIOUR OF THE ESRO 1 (AURORAE) SATELLITE

M. Toussaint 23 Oct. 1969 325 p refs

(Contract ESRO-740/69-SL)

(NT/D1/69/158) Avail: NTIS HC$6.00/MF$0.95

A comparison is carried out between inflight temperatures of the AURORAE (ESRO 1) satellite, and the theoretical values which can be computed by using a mathematical model of the spacecraft and an adequate representation of the space environment. ESRO

N71-24656*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SOME LANDING GEAR CONSIDERATIONS FOR SPACE SHUTTLE VEHICLES

Brantley R. Hanks and Trafford J. W. Leland *In its* NASA Space Shuttle Technol. Conf., Vol. 3 Apr. 1971 p 121-154 refs (See N71-24651 13-32)

Avail: NTIS HC$6.00/MF$0.95 CSCL 22B

Criteria for designing space shuttle landing systems were studied including landing conditions, requirements, constraints, and types of landing gear. The types of landing gear discussed are conventional wheel with tire, metal or wire brush wheels, skids, wheel with tire and skid brakes, and air cushion with skid brakes. F.O.S.

N71-24657*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

RECENT STUDIES OF EFFECTS OF GROUND WINDS ON SPACE SHUTTLE VEHICLES

Robert W. Hess, Wilmer H. Reed, III, and Jerome T. Foughner, Jr. *In its* NASA Space Shuttle Technol. Conf., Vol. 3 Apr. 1971 p 155-179 refs (See N71-24651 13-32)

Avail: NTIS HC$6.00/MF$0.95 CSCL 22A

Ground-wind load studies were conducted with models of space-shuttle configurations to assess the importance of aerodynamic instabilities on erected space-shuttle vehicles. Regions of instability for stop-sign flutter and galloping instability are identified and their significance for the full-scale vehicle is examined. Aerodynamic drag coefficients were measured for two booster configurations with and without an orbiter, and the effect of Reynolds number on galloping instability was explored for one configuration. Author

N71-24658*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECTS OF SPACE SHUTTLE CONFIGURATION ON WING BUFFET AND FLUTTER. PART 1: LAUNCH VEHICLE WITH TIP FIN

Robert C. Goetz *In its* NASA Space Shuttle Technol. Conf., Vol. 3 Apr. 1971 p 181-199 refs (See N71-24651 13-32)

Avail: NTIS HC$6.00/MF$0.95 CSCL 22B

Several emerging configuration features of the space shuttle vehicle are examined in an effort to determine their influence on wing aeroelastic behavior. Configuration features discussed include wings with intersecting surfaces, wings in proximity to one another, and thick wings at high angles of attack. Some recent experimental results are presented that are applicable to these configuration features. These results indicate that large tip fins proposed for launch vehicle wings have a detrimental effect on the wing flutter characteristics over the subsonic and transonic speed range; that aerodynamic interference effects of wings in proximity affect their transonic flutter behavior, and that a continuing investigation to determine the exact effects for specific configurations is needed; that thick delta wings with tip fins will experience buffet during launch, and that maximum buffeting associated with a current design was encountered between angles of attack from about 25 to 30 deg. The full-scale maximum buffet intensities were higher than those associated with more conventional wing configurations. Author

N71-24666*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SHUTTLE POGO REVIEW

John E. Harbison *In its* NASA Space Shuttle Technol. Conf., Vol. 3 Apr. 1971 p 359-399 (See N71-24651 13-32)

Avail: NTIS HC$6.00/MF$0.95 CSCL 22A

Preliminary results of POGO stability analyses are presented. Topics discussed include data flow diagrams for POGO analysis, longitudinal mode shapes, structural sensitivity, propulsion estimators, and dynamic characteristics. F.O.S.

N71-24667*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SPACE SHUTTLE ACOUSTICS

Stanley H. Guest *In its* NASA Space Shuttle Technol. Conf., Vol. 3 Apr. 1971 p 401-422 (See N71-24651 13-32)

Avail: NTIS HC$6.00/MF$0.95 CSCL 22A

The farfield and nearfield acoustic environments of the space shuttle are studies with the vehicle environments induced by the supersonic exhaust flow. The acoustic power spectra are discussed for Saturn 1B, Saturn 5, and the space shuttle. It is concluded that the shuttle environments for the adjacent and farfield exceed those of Saturn 5. Fatigue of structures, and thermal coatings is a major problem with the crew environments. F.O.S.

N71-24678*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.

SPACE SHUTTLE LOW PRESSURE AUXILIARY PROPULSION SUBSYSTEM DESIGN DEFINITION Subtask A Report

A. S. Kendall, H. B. McKee, and G. F. Orton 29 Jan. 1971 305 p refs

(Contract NAS9-11012)

(NASA-CR-114999; MDC-E0303) Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

Results of a study defining the most attractive low pressure, oxygen/hydrogen auxiliary propulsion subsystem (APS) for space

shuttle boosters and orbiters are presented. The preferred APS concepts for both use main engine propellant tanks as low pressure gas accumulators. The primary vehicle requirements and their impact on APS are described. Engine thrust levels, number of engines, and mission total impulse allocations for each booster and orbiter are identified. The candidate APS concepts are defined, and details are given on the tradeoffs and comparisons leading to selection of preferred concepts for the reference space shuttles. Author

N71-24677*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
SPACE SHUTTLE HIGH PRESSURE AUXILIARY PROPULSION SUBSYSTEM DEFINITION STUDY Subtask A Report
D. D. Anglim, T. L. Baumann, and L. H. Ebbesmeyer 12 Feb. 1971 293 p refs
(Contract NAS8-26248)
(NASA-CR-103109; MDC-E0297) Avail: NTIS CSCL 22B

Results are presented of the high pressure auxiliary propulsion subsystem (APS) to provide sufficient comparative data on various APS concepts to allow selection of the best approach for preliminary design. The conceptual subsystem definition results are summarized, including concept trade studies, study approach, requirements used, and concepts considered. Background data for APS models used in the trade studies, and data and rationale used for initial screening of candidate concepts are also provided. Author

N71-24678*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
SPACE SHUTTLE HIGH PRESSURE AUXILIARY PROPULSION SUBSYSTEM DEFINITION STUDY. DESIGN HANDBOOK
T. S. Herm and F. W. Houte 12 Feb. 1971 132 p refs
(Contract NAS8-26248)
(NASA-CR-103110; MDC-E0300) Avail: NTIS CSCL 22B

The handbook provides subsystem design and operational description, along with a guide for subsystem design reflecting requirements other than those specifically investigated during the study. This handbook includes schematics and physical descriptions; pressures, temperatures and flow balances; estimated weights; and transient and steady state operating characteristics. Author

N71-24701*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PERFORMANCE AND DYNAMICS OF AEROSPACE VEHICLES
Washington 1971 670 p refs
(NASA-SP-258; L-6892) Avail: NTIS HC $9.00/MF $0.95 CSCL 01A

CONTENTS:

1. STABILITY AND CONTROL CHARACTERISTICS OF STOL AND V/STOL AIRPLANES J. R. Chambers p 1-69 refs (See N71-24702 13-02)

2. METHODS OF OBTAINING STABILITY DERIVATIVES M. J. Queijo p 71-101 refs (See N71-24703 13-01)

3. DESIGN OF BODIES FOR LOW DRAG AND HIGH PERFORMANCE IN PRACTICAL HYPERSONIC FLIGHT E. S. Love p 103-174 refs (See N71-24704 13-01)

4. PROBLEMS OF ATMOSPHERIC ENTRY P. J. Bobbitt p 175-288 refs (See N71-24705 13-31)

5. FLUTTER AND UNSTEADY LIFT THEORY E. C. Yates, Jr. p 289-374 refs (See N71-24706 13-01)

6. EFFECTS OF AEROELASTICITY ON STATIC AERODYNAMIC DERIVATIVES J. E. Lamar p 375-438 refs (See N71-24707 13-01)

7. RESPONSE OF FLEXIBLE AIRPLANES TO ATMOSPHERIC TURBULENCE K. G. Pratt p 439-503 refs (See N71-24708 13-02)

8. GUST ALLEVIATION W. H. Phillips p 505-553 refs (See N71-24709 13-01)

9. HUMAN RESPONSE IN CLOSED LOOP CONTROL OF DYNAMIC SYSTEMS J. J. Adams p 555-577 refs (See N71-24710 13-05)

10. INTRODUCTION TO LINEAR SYSTEM ANALYSIS AND DESIGN BY USE OF STATE VECTOR APPROACH R. C. Vector p 579-628 refs (See N71-24711 13-02)

11. OPTIMIZATION TECHNIQUES E. S. Armstrong p 629-675 refs (See N71-24712 13-02)

N71-24705*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PROBLEMS OF ATMOSPHERIC ENTRY
Percy J. Bobbitt *In its* Performance and Dyn. of Aerospace Vehicles 1971 p 175-288 refs (See N71-24701 13-31)
Avail: NTIS HC $9.00/MF $0.95 CSCL 22A

Aerodynamic and heating problems of planetary entry are discussed with particular emphasis on Mars and Venus. Real-gas and atmospheric-composition effects on the drag and radiative and convective heating of entry spacecraft are illustrated. Considerations involved in the selection of an ablation material are reviewed and typical heat protection weights given. Aerodynamic data for blunt cones from a number of different facilities are shown and some of the shortcomings of various test techniques pointed out. Author

N71-24749*# North American Rockwell Corp., Downey, Calif. Space Div.
ORBITING LUNAR STATION PHASE A FEASIBILITY AND DEFINITION STUDY: CONDENSED SUMMARY REPORT Final Report
L. R. Hogan Apr. 1971 38 p
(Contract NAS9-10924)
(NASA-CR-115003; SD-71-208) Avail: NTIS CSCL 22B

The study objectives are enumerated, principal assumptions identified, significant results presented, and implications on the EOSS are identified, as well as topics for additional study. Author

N71-24750* Aerojet-General Corp., El Monte, Calif.
ATTITUDE CONTROL SYSTEM FOR SOUNDING ROCKETS Patent
Howard J. Robbins and Zbiggie E. Zebrowski, inventors (to NASA) Issued 1 Nov. 1966 (Filed 19 Feb. 1965) 8 p Cl. 102-50 Sponsored by NASA
(NASA-Case-XGS-01654; US-Patent-3,282,541; US-Patent-Appl-SN-434148) Avail: US Patent Office CSCL 22B

A system for controlling the attitude of sounding rockets during the ballistic phase of the flight is described. The system consists of a timer controlled programmer and position and rate gyroscopes to apply corrective signals from the position gyroscopes to the reaction jet nozzles. Solenoid controlled valves and a propellant pressurization gas source provide controlling moments for the rocket vehicle. Official Gazette of the U.S. Patent Office

N71-24812*# National Aeronautics and Space Administration, Washington, D.C.
THE METEOSAT SYSTEM [LE SYSTEME METEOSAT]
H. Felix May 1971 68 p Transl. into ENGLISH from the French Report
(NASA-TT-F-13646) Avail: NTIS CSCL 22B

The French Meteosat weather satellite and associated ground systems are described. Operational characteristics of the system are given, as well as a weight and power breakdown of the satellite. An over-all program plan is presented. Launch is scheduled for 1975 aboard a Thor rocket. A large number of ground stations are contemplated. Author

N71-24813* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

DEEP SPACE MONITOR COMMUNICATION SATELLITE SYSTEM Patent

George W. Clemens, Jr. and Alfred C. Mascy, inventors (to NASA) Issued 10 Nov. 1970 (Filed 19 Oct. 1966) 16 p Cl. 343-100; Int. Cl. B64g3/00; Int. Cl. H04b7/20

(NASA-Case-XAC-06029-1; US-Patent-3,540,048; US-Patent-Appl-SN-588651) Avail: US Patent Office CSCL 22B

The use of a single Earth orbiting relay communications satellite to eliminate the tracking occultation problems experienced by ground tracking stations continuously monitoring interplanetary missions is discussed. The tracking occultation experienced by ground tracking stations is caused by the Earth's rotation and atmosphere giving a constantly changing and distorted line-of-sight between the tracking station and the interplanetary mission being monitored. This problem is eliminated when using the relay satellite by the proper selection of the satellite's orbital parameters to give a minimum angular change between the line-of-sight between Earth and the space vehicle relative to the orbital plane of the satellite. This condition is achieved by placing the communications relay satellite in a nearly polar orbit, which has an orbital plane perpendicular to the line-of-sight between the Earth and the interplanetary space vehicle.

Official Gazette of the U.S. Patent Office

N71-24822*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL EVALUATION OF A PURGED SUBSTRATE MULTILAYER INSULATION SYSTEM FOR LIQUID HYDROGEN TANKAGE

Richard L. DeWitt and Max B. Mellner Washington May 1971 65 p refs

(NASA-TN-D-6331; E-6036) Avail: NTIS CSCL 13D

Seven space-hold and six ground-hold tests were conducted to determine the thermal performance of a GHe purged substrate multilayer blanket insulation system on a 7 ft (2.134 m) diam spherical LH2 tank. Space-hold tests were made using 30, 40, 50, and 60 insulation shields. No serious degradation of the space-hold thermal performance of the 30 layer system was observed over consecutive cyclic tests. The space-hold performance was found to be a strong function of the technique of application. The main source of unexpected heat leak during ground hold was believed due to condensing and freezing of nitrogen in the insulation blankets.

Author

N71-24823*+ General Dynamics/Convair, San Diego, Calif. Aerospace Div.

SPACE SHUTTLE SYNTHESIS PROGRAM (SSSP). VOLUME 1: PART 1: ENGINEERING AND PROGRAMMING DISCUSSION Final Report

Dec. 1970 238 p refs

(Contract NAS9-11193)

(NASA-CR-114986; GDC-DBB70-002-Vol-1-Pt-1) Avail: NTIS CSCL 22B

The basic user's manual text and all of the simulation input and output descriptions are presented for the Space Shuttle Synthesis Program (SSSP) as well as a complete listing of the computer program FORTRAN 5 source deck. The SSSP was developed to provide a fast but moderately detailed and accurate tool for Space Shuttle launch vehicle sizing and performance evaluation. The two-stage Space Shuttle system is a completely reusable space transportation system consisting of a booster and an orbiter element. The SSSP couples weight/volume and trajectory computations in one computer program and provides a proper interface between vehicle design parameters and the trajectory throughout trade studies for two-stage fully recoverable Space Shuttle systems. The program was assembled by using the subroutine building-block approach with the two major subprograms (weight/volume and trajectory) and with the executive program which acts as the interface between the two major subprograms. The executive program, or synthesis driver, provides the iteration logic and adjustments required for consistency among the weight, volume, geometry and trajectory data and mission constraints.

Author

N71-24824*+ General Dynamics/Convair, San Diego, Calif. Aerospace Div.

SPACE SHUTTLE SYNTHESIS PROGRAM (SSSP). VOLUME 1: PART 2: PROGRAM OPERATING INSTRUCTIONS Final Report

Dec. 1970 114 p refs

(Contract NAS9-11193)

(NASA-CR-114984; GDC-DBB70-002-Vol-1-Pt-2) Avail: NTIS CSCL 22B

The development structure, and usage of the Space Shuttle Synthesis Program (SSSP) are discussed. The overall organization, engineering development, program options, and operating modes are described. A discussion of the operational procedures for the program is presented along with a discussion of each subroutine, the data-deck set up, and input parameters.

Author

N71-24825*+ General Dynamics/Convair, San Diego, Calif. Aerospace Div.

SPACE SHUTTLE SYNTHESIS PROGRAM (SSSP). VOLUME 1: PART 3: PROGRAM OUTPUT Final Report

Dec. 1970 353 p refs

(Contract NAS9-11193)

(NASA-CR-114985; GDC-DBB70-002-Vol-1-Pt-3) Avail: NTIS HC $6.00 CSCL 22B

Data output blocks are outlined for the Space Shuttle Synthesis Program (SSSP) including output weight, geometry, and trajectory simulation parameters. Error diagnostics are discussed as well as a sample case with vehicle sizing, synthesis iteration, and trajectory simulation data bases. Elemental coordinate transformations, GTSM subprogram principle parameters and subscript arrays, the Cape Kennedy reference atmosphere table, the computer program FORTRAN list, specified input parameters, synthesis driver principle subscripted arrays, and the sample case listing are appended.

J.M.

N71-24826*+ General Dynamics/Convair, San Diego, Calif. Aerospace Div.

SPACE SHUTTLE SYNTHESIS PROGRAM (SSSP). VOLUME 2: WEIGHT/VOLUME HANDBOOK Final Report

Dec. 1970 162 p refs

(Contract NAS9-11193)

(NASA-CR-114987; GDC-DBB70-002-Vol-2) Avail: NTIS CSCL 22B

A compilation of statistical data on previous aircraft, missile, and spacecraft systems is presented which serves as background information and program inputs for the weight/volume portion of the Space Shuttle Synthesis Program (SSSP). Detailed engineering descriptions of space shuttle aerodynamic surfaces; body structure; induced environment protection; launch and recovery; and main propulsion are given as well as orientation controls and separation; power supply conversion and distribution; avionics systems; personnel provisions; design reserve; personnel; payload; propellants; and descriptive geometry.

J.M.

N71-24842*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AERONAUTICAL SATELLITE SYSTEM CHARACTERISTICS AND PROPAGATION FACTORS THROUGH 1971

E. J. Mueller Mar. 1971 63 p refs

(NASA-TM-X-65511; X-490-71-91) Avail: NTIS CSCL 22B

A bibliography is presented covering the following air traffic control subcategories: air traffic, communication, surveillance, and navigation system requirements, satellite design, aircraft equipment, earth-space propagation, ionospheric phenomena, and VHF and L band propagation. E.C.

N71-24943*# Monsanto Research Corp., Dayton, Ohio.
IDENTIFICATION OF VOLATILE CONTAMINANTS OF SPACE CABIN MATERIALS Final Report, Jan. 1968–Jan. 1969
J. V. Pustinger, Jr., F. N. Hodgson, and J. E. Strobel Wright-Patterson AFB, Ohio AMRL Sep. 1969 221 p refs Supported in part by NASA
(Contract F33615-67-C-1357)
(NASA-CR-118323; AD-701039; AMRL-TR-69-18) Avail: NTIS CSCL 06K

Seventy-two candidate space cabin materials were tested to determine weight-loss characteristics and to identify their gas-off products. The materials were screened initially, using thermogravimetric techniques for measuring weight loss at moderate temperatures (ambient to 68C) for 24 hours in 5 psia nitrogen, to select those candidate materials that lose from 0.001 to 1.0% of their weight, excluding water. The gaseous contaminants evolved from the test materials were identified by combinations of gas chromatography and mass spectrometry. An additional study was made to determine the decomposition temperatures and products of degradation for carboxynitroso rubber. Author (GRA)

N71-25068*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
SPACE SHUTTLE HIGH PRESSURE AUXILIARY PROPULSION SUBSYSTEM DEFINITION STUDY Summary Report
P. J. Kelly and W. W. Regnier 12 Feb. 1971 72 p refs
(Contract NAS8-26248)
(NASA-CR-103115; MDC-E0299) Avail: NTIS CSCL 22B

Effort in support of the high pressure H2/O2 auxiliary propulsion subsystem, the preliminary design, and the study approach and results are summarized. In the conceptual subsystem definition study, data for the selection of the best concept were obtained by comparing all candidates on the basis of weight, technology, simplicity, and flexibility. The turbopump concept was chosen for both boosters and orbiters. In the preliminary design stage, optimization of an integrated design was accomplished through a series of interrelated studies associated with components, assemblies, and subsystems. N.E.N.

N71-25069*# National Aeronautics and Space Administration, Washington, D.C.
DESIGN-DEVELOPMENT TESTING: SPACE VEHICLE DESIGN CRITERIA
May 1970 35 p refs
(NASA-SP-8043) Avail: NTIS CSCL 22B

The testing of any element or component whose principal function is structural is discussed. Criteria are presented and recommendations made for planning tests and establishing test requirements. Author

N71-25075*# National Aeronautics and Space Administration, Washington, D.C.
SPACE RADIATION PROTECTION: SPACE VEHICLE DESIGN CRITERIA
Jun. 1970 50 p refs
(NASA-SP-8054) Avail: NTIS CSCL 22B

The criteria and procedures for determining doses caused by penetrating space radiation and the design of appropriate protection for space vehicles were studied to avoid exceeding specified allowable levels of radiation dose and/or dose rate for the duration of the mission. The approach is first to calculate the doses received by each radiation-sensitive item, considering the protection inherent in the vehicle structure and contents, and the space radiation environment encountered during the mission. If any doses exceed allowable limits, then the design of shielding is implemented to reduce the doses to meet the specifications, unless the adjustment of mission parameters or system design (or specifications) can eliminate the necessity. Author

N71-25102*# North American Rockwell Corp., Downey, Calif. Space Div.
ORBITING LUNAR STATION PHASE A FEASIBILITY AND DEFINITION STUDY. VOLUME 6 COMPARISON OF OLS CONFIGURATIONS Final Report
Apr. 1971 185 p
(Contract NAS9-10924)
(NASA-CR-115020; SD-71-207-Vol-6; MSC-02687-Vol-6) Avail: NTIS CSCL 22B

An analysis of the configuration of the Orbiting Lunar Station is presented. Configuration comparisons between the representative and derivative OLS configurations, and cost and schedule projections of two configurations are discussed. Author

N71-25103*# TRW Systems Group, Redondo Beach, Calif.
APOLLO CRYOGENIC INTEGRATED SYSTEMS PROGRAM
R. K. M. Seto, C. E. Barton, and J. E. Cunningham May 1971 87 p refs
(Contract NAS9-8166)
(NASA-CR-115022; TRW-17618-H153-R0-00) Avail: NTIS CSCL 22B

Computer programs for simulating both nominal and anomalous operation of the Apollo Cryogenics Storage System (CSS) are discussed. Two versions of the program exist; one for the Apollo 14 configuration and the other for J type mission configurations. The program consists of two mathematical models which are dynamically coupled. A model of the CSS components and lines determines the oxygen and hydrogen flowrate from each storage tank given the tank pressures and temperatures, and the Electrical Power Subsystem (EPS) and Environmental Control Subsystem (ECS) flow demands. Temperatures and pressures throughout the components and lines are also determined. A model of the CSS tankage determines the pressure and temperatures in the tanks given the flowrate from each tank and the thermal environment. The model accounts for tank stretch and includes simplified oxygen tank heater and stratification routines. Supporting subroutines are used to calculate thermophysical properties and to calculate the CSS thermal environment during various mission phases. Author

N71-25128*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRACKING AND DATA SYSTEM SUPPORT FOR THE PIONEER PROJECT. PIONEER 8, EXTENDED MISSION: 1 JUNE 1968–1 JULY 1969, VOLUME 8
N. A. Renzetti 1 May 1971 207 p refs
(Contract NAS7-100)
(NASA-CR-118328; JPL-TM-33-426-Vol-8) Avail: NTIS CSCL 22C

The Pioneer 8 mission (outward trajectory and heliocentric orbit) employed seven scientific instruments to accumulate information relative to interplanetary high energy particles, solar phenomena, and plasma. The spacecraft also served as a celestial mechanics experiment reference point, and carried aloft a piggy-back satellite, called the Test and Training Satellite, to be used for Apollo ground station crew training and mission simulation. Deep space tracking for the first period of the extended flight phase was made possible for the Deep Space Network which responded to all tracking, telemetry, command, monitoring, simulation, and operations control requirements. Author

N71-25154*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

STATIC STABILITY CHARACTERISTICS OF MSC ORBITER: TESTS AT MACH NUMBER 7.4
John A. Axelson Jan. 1970 56 p
(NASA-TM-X-62035) Avail: NTIS CSCL 22B

The hypersonic aerodynamic characteristics for a 1/80-scale model of the space shuttle orbiter are presented for angles of attack from 0 deg to 90 deg and sideslip angle from 0 deg to 16 deg at a Mach number of 7.4 and a test Reynolds number of 2.1 million per foot. The tests were conducted in the 3.5-foot hypersonic wind tunnel and included the component build up and a wide range of elevator angles between + or − 40 deg. Author

N71-25155*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMPUTATION OF STRUCTURAL MODES OF A ROLLOUT ARRAY SPACECRAFT FOR ATTITUDE CONTROL STUDY
Evan O. Weiner 1 May 1971 45 p refs
(Contract NAS7-100)
(NASA-CR-118327; JPL-TM-33-476) Avail: NTIS CSCL 22B

The structural modes required to determine the interaction between an attitude control system and a flexible structure are studied. The flexible structure has a low stiffness that leads to natural frequencies in the range of the frequency response of the attitude control system, producing a coupling between the response of the structure and the attitude control system. Author

N71-25156*# Philco-Ford Corp., Palo Alto, Calif. Western Development Labs. Div.
APOLLO WINDOW DEFORMATION AND RAY TRACE ANALYSES Technical Report, Jun. 1968 – Aug. 1970
David M. Kelley Nov. 1970 244 p refs
(Contract NAS2-5044)
(NASA-CR-114275) Avail: NTIS CSCL 22B

Results of deformation and ray trace analyses of the Apollo spacecraft side window are described. The window is studied isolated with simply supported edges, isolated with clamped edges, and in its Apollo structural environment. Data are appropriate for correcting scientific observations and evaluating the effect of window support on optical performance. Deformations based on a finite element analysis and the errors associated with the analyses are reported. They are within the one second of arc accuracy required for ray tracing. Contours of equal deflection for the configurations analyzed are presented. Deviations of light rays entering the window on a one-inch grid for in-flight loading conditions are cited. Deviations are given for both single and two ray sextant observations for the window in its structural environment. Areas of the window in the Apollo structure through which observations can be made without interference from the supporting structure are identified. For single line-of-sight observations, this area is centered on the window. For sextant observations, the area is skewed toward the edge of the window. Author

N71-25308*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN ANALYSIS OF THERMALLY INDUCED OSCILLATIONS OF STEM TYPE BOOMS
Harold P. Frisch *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 216–220
(See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 22B

A computer program was developed and used to analyze thermal processes that induce vibrations in rigid rod booms. Booms were assumed to rest, rigidly clamped at one end, and free both to translate and rotate at the other end; solar illumination provided the only source of disturbance. Results of these calculations show how nonplanar tip motions grow in amplitude as a function of time and how increased torsional rigidity by only a factor of 15 stabilizes a 60-ft OGO 4 boom. Resultant use of two torsionally rigid 30-ft booms on an OGO 6 satellite for approximately 6 months proved their stabilization. G.G.

N71-25334*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A TECHNIQUE FOR THE DETERMINATION OF THE DIPOLE MOMENT OF A SPACECRAFT FROM A LIMITED AMOUNT OF NEAR FIELD DATA
William L. Eichhorn *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 324–328
(See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 22B

A two step procedure is described that determines spacecraft dipole moment from field measurements obtained by rotation of the spacecraft about its vertical axis. Data from magnetometer sensors are first Fourier analyzed to obtain the first three Fourier coefficients; these coefficients are then used to solve a set of simultaneous equations for each of the three dipole moment components. Test results using this method give correct answers within about 6 percent error. G.G.

N71-25387# Accumetrics Corp., Cambridge, Mass.
FLIGHT DATA ANALYSIS AND ELECTROMECHANICAL SIMULATION OF SOUNDING ROCKET STABILITY Final Report, 25 Aug. 1969 – 24 Jan. 1971
Donald H. Fryklund and Oiva R. Anderson 24 Nov. 1970 63 p refs
(Contract F19628-70-C-0047)
(AD-719758; AC-122; AFCRL-71-0073) Avail: NTIS CSCL 14/2

The post-burnout angular motions of three divergent NIKE sounding rocket flights have been examined using rigid body energy techniques previously developed. Two of these flights exhibited roll-pitch lock-in through burnout and for several seconds after. All exhibited a rapid initial increase in coning angle followed by an actual decrease and a later more gradual divergence consistent with increased altitude. The rigid body kinetic energy histories show a double peaked character which implies that energy is temporarily stored internally such as in structural deformation. The magnitude of the energy in transverse motion is small enough so that de-spun damping of reasonable weight penalty is feasible. The previous study indicated that coning divergence of a spin-stabilized sounding rocket could be eliminated by the use of a passive de-spun rotor stabilization system. Author (GRA)

N71-25389*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
ANALYTICAL MODEL FOR DETERMINING SPACECRAFT IMPACT VELOCITY AND ORIENTATION RELATIVE TO AN IMPACT SURFACE
David B. Howes and Arthur M. Whitnah Washington May 1971 20 p refs
(NASA-TN-D-6325; MSC-S-237) Avail: NTIS CSCL 22B

An analytical model which can be used to determine spacecraft impact velocity and orientation relative to an impact surface for variable dynamic conditions determined by the atmosphere, the landing system or spacecraft (or both), and the impact surface has been developed. These impact condition values can be used in the determination of impact loads. Author

N71-25434* North American Rockwell Corp., Downey, Calif.
SPACECRAFT Patent
Earl M. Van Alstyne, inventor (to NASA) Issued 15 Dec. 1970 (Filed 15 Aug. 1969) 6 p Cl. 244-1; Cl. 244-113; Cl. 244-138; Int. Cl. B64g1/00 Sponsored by NASA
(NASA-Case-MSC-13047-1; US-Patent-3,547,376; US-Patent-Appl-SN-850586) Avail: US Patent Office CSCL 22B

A spacecraft is described with an aerodynamic outer shell which acts as the heat shield. It includes an excursion module removably housed within the shell, with the module having a retracted landing gear and a forwardly thrusting thrust means, such as an engine, at the forward end thereof and a crew station generally rearward of the landing gear. It also includes means for

separating the module from the shell after separation, whereby the spacecraft can then be landed by activation of the thrust means to land the vehicle forward end down.
Official Gazette of the U.S. Patent Office

N71-25435*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THORAD-AGENA ASCENT AND AGENA ORBITAL PERFORMANCE EVALUATION FOR SPACE ELECTRIC ROCKET TEST 2 (SERT 2) MISSION
Washington May 1971 122 p
(NASA-TM-X-2188; E-5982) Avail: NTIS CSCL 22A

A Thorad-Agena launch vehicle successfully placed the Space Electric Rocket Test II (SERT 2) spacecraft onto a near-polar, sun-synchronous, near-circular orbit at an altitude of about 1010 kilometers. The SERT 2 spacecraft, containing two experimental electron-bombardment mercury-ion thrusters, was part of an orbital vehicle that also included a spacecraft support unit, the Agena, and two solar arrays. An evaluation of the Thorad-Agena systems during ascent to the proper orbit, and an evaluation of the Agena systems used for the first in-orbital support of an NASA unmanned program are presented. Author

N71-25470*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
SPACE SHUTTLE LOW PRESSURE AUXILIARY PROPULSION SUBSYSTEM DESIGN DEFINITION Subtask B Report
W. M. Green and T. C. Patten 29 Jan. 1971 235 p refs
(Contract NAS9-11012)
(NASA-CR-115000; MDC-E0302) Avail: NTIS CSCL 22B

The preliminary effort to design a low pressure, oxygen/hydrogen auxiliary propulsion system (APS) for space shuttle boosters and orbiters is described. The selected orbiter APS concept incorporates auxiliary liquid propellant storage, passive tank mounted heat exchangers, and a constant density control scheme. The heat exchangers condition the main engine tank resupply propellant. The stiffness associated with the heat exchanger tubes allowed a reduction in tank rib height (O sub 2 tank only) and consequently reduced the heat exchanger weight penalty. Propellant resupply requirements were minimized by (1) using a compartmented O sub 2 tank to hold main engine tank residual O sub 2 liquid and (2) operating the system in a mixed mode where liquid-vapor mixing and constant density control are provided only during high usage periods. During low usage, propellant vapors are extracted from the main engine tanks and supplied directly to the engines. This reduces the control complexity required. The booster APS consists of propellant distribution and engine assemblies. It operates entirely from main engine tank residual propellants. Extraction of liquid residual propellants is prevented by g-sensitive valves which allow only vapors to be withdrawn. Author

N71-25471*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
SPACE SHUTTLE HIGH PRESSURE AUXILIARY PROPULSION SUBSYSTEM DEFINITION STUDY Subtask B Report
R. D. Gaines, A. I. Goldford, and T. A. Kaemming 12 Feb. 1971 408 p refs
(Contract NAS8-26248)
(NASA-CR-103108; MDC-E0298) Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

The preliminary effort to design a high pressure, oxygen/hydrogen auxiliary propulsion system (APS) for space shuttle boosters and orbiters is described. The APS selected for all vehicles utilized a turbopump subassembly to provide the pressure required for subsystem operation. In this concept, hydrogen and oxygen propellants are stored as cryogenic liquids and supplied to the subsystem by turbopumps and temperature conditioned in reburn heat exchangers. Combustion products from gas generators are used in turbines to power the turbopumps. Exhaust gas from the turbines are routed to heat exchangers where additional oxygen is added and the mixture reburned to provide the energy for propellant conditioning. Resultant conditioned propellants are stored in accumulators until they are required for APS thruster usage. The study effort, subsystem operating and performance characteristics, component and assembly designs, installation features, weight, and reliability estimates, and critical technology are included. Author

N71-25577*# TRW Systems Group, Redondo Beach, Calif.
SPACE STORABLE PROPELLANT MODULE THERMAL CONTROL TECHNOLOGY. VOLUME 1: OF2/B2H6 PROPULSION MODULE Summary Report
R. E. De Land, O. O. Haroldsen, and R. N. Porter 15 Mar. 1971 215 p refs Prepared for JPL
(Contract NAS7-750)
(NASA-CR-117900; TRW-14051-6009-R0-00-Vol-1) Avail: NTIS CSCL 13D

The design criteria, final module design, thermal analyses, and propulsion system operation of an OF2/B2H6 propulsion module for a Jupiter mission are described in detail. The design includes a single tank for each propellant, a constant temperature RTG, a structural configuration utilizing a truss system with a propellant tank support platform and providing a clear view of space and the RTG, nonmetallic struts to stabilize the tank top, a bottom support frame of metal members and an aluminum beam supporting the helium tank, nonporous foam insulation for the tanks, liquid nitrogen cooling coils inside each tank to provide cooling during groundhold, and two passive radiators for each propellant tank for flight thermal control. The module weight without fluids is 502.9 lb; the spacecraft weight is 1200 lb. N.E.N.

N71-25578*# TRW Systems Group, Redondo Beach, Calif.
SPACE STORABLE PROPELLANT MODULE THERMAL CONTROL TECHNOLOGY. VOLUME 2: F2/N2H4 PROPULSION MODULE Summary Report
R. E. De Land, O. O. Haroldsen, and R. N. Porter 15 Mar. 1971 129 p refs Prepared for JPL
(Contract NAS7-750)
(NASA-CR-117959; TRW-14051-6009-R0-00-Vol-2) Avail: NTIS CSCL 13D

The design criteria, final module design, thermal analyses, and propulsion system operation of an F2/N2H2 propulsion module for a Jupiter mission are described in detail. The general design uses the same general structural configuration established for the OF2/B2H6 module, except that nonmetallic structural members are used in most places to prevent conduction of heat to the fluorine. The design includes a single tank for each propellant and the pressurant, 2-inch thick nonporous foam insulation for the fluorine tank, multilayer aluminized Mylar insulation for the N2H2 tank, fluorine tank conditioning during groundhold by circulation of LN2 or chilled helium through coils inside the tank, fluorine temperature control during flight by tank heat radiation to space, and effective thermal control over engine and related components by conductive and radiative heat transfer paths between the equipment itself and between the equipment and the RTG. N.E.N.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N71-24371# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugzeugbau.

BIBLIOGRAPHY ON STRUCTURAL STABILITY OF CONICAL AND SPHERICAL THIN SHELLS, 1916–1970
Willy Schluenz, comp. Nov. 1970 123 p refs
(DLR-MITT-70-20) Avail: NTIS; ZLDI Munich: 24 DM

The bibliography is a supplement of the Bibliography 4 under the same title, published September 1961 by the Advisory Group for Aeronautical Research Development (AGARD) and has been compiled by the Institut fuer Flugzeugbau of the Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt (DFVLR), e.V. Braunschweig, Germany. The AGARD-Bibliography 4 contains 168 references with abstracts in the time interval from 1900 to 1961, including a list of general and special abbreviations and an author index. This bibliography contains 300 further references with abstracts, if available, in the time interval from 1916 to 1970, especially from 1961 to 1970 (from 1916 to 1961 some blanks could be filled up). Author (ESRO)

N71-24493# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugzeugbau.
THE APPLICATION OF THE RAYLEIGH-RITZ METHOD MESHWISE INTERPOLATION FOR CALCULATING THE BUCKLING LOADS OF SHELLS WITH VARIABLE STRESS DISTRIBUTIONS [DIE ANWENDUNG DES VERFAHRENS VON RAYLEIGH-RITZ MIT MASCHENWEISER INTERPOLATION ZUR BERECHNUNG DER BEULLASTEN VON SCHALEN MIT VARIABLER SPANNUNGSVERTEILUNG]
Klaus Rohwer Oct. 1970 27 p refs In GERMAN; ENGLISH summary
(DLR-FB-70-71) Avail: NTIS; ZLDI Munich: 8.50 DM

The buckling loads of rectangular shallow shells with arbitrary membrane stress distributions are investigated. The shell structures may be of Kirchhoff or of sandwich-type. The buckling loads are determined as eigenvalues from a Ritz set-up with meshwise Hermite interpolation polynomials. The results of four computed examples are given. Author (ESRO)

N71-24616# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
COMPRESSION OF AN ELASTIC ROLLER BETWEEN TWO RIGID PLATES
Eli Sternberg and Matias J. Turteltaub Jan. 1971 43 p refs
(Contract N00014-67-A-0094-0020)
(AD-719376; TR-22) Avail: NTIS CSCL 13/9

A closed solution-exact within two-dimensional linear elastostatics - is deduced for the problem appropriate to the compression of an elastic circular cylinder between two smooth, flat and parallel, rigid plates. The boundary displacements obtained for the cylinder involve elliptic integrals, whereas its stress field is given in terms of elementary functions exclusively. The results found for the distribution of the contact pressure and for the width of the contact zone are compared with the corresponding predictions of Hertzs approximate theory, for which elementary corrections are determined by asymptotic means. Analogous corrections are established for a previously available approximate estimate of the diametral compression undergone by the roller, which remains indeterminate in the Hertz treatment of this two-dimensional contact problem. Author (GRA)

N71-24642*# George Washington Univ., Washington, D.C. Engineering Mechanics Dept.
PROBLEMS IN STRESS ANALYSIS AND OPTIMUM DESIGN Final Report, 1 Feb. 1969 – 1 Feb. 1970
Barry I. Hyman Feb. 1970 352 p refs
(Grant NGR-09-010-053)
(NASA-CR-111891) Avail: NTIS HC $6.00/MF $0.95 CSCL 20K

CONTENTS:

1. STRESS ANALYSIS OF THIN ELASTO-PLASTIC SHELLS B. I. Hyman and O. Lomacky (Naval Ship Res. and Develop. Center) 49 p refs (See N71-24643 13-32)

2. EXPLORATORY TESTS ON FIBER-REINFORCED PLATES WITH CIRCULAR HOLES UNDER TENSION B. I. Hyman, A. De Turk, R. Diaz, and G. Di Giovani 2 p refs (See N71-24644 13-32)

3. THE STRESS-STRAIN RELATIONS FOR A NONHOMOGENEOUS COMPOSITE WITH A CIRCULAR INCLUSION W. T. Packard and B. I. Hyman 62 p refs (See N71-24645 13-32)

4. EXPERIMENTAL STRESS ANALYSIS OF COMPOSITE PLATES WITH HOLES J. Nilforoush and B. I. Hyman 64 p refs (See N71-24646 13-32)

5. STRESSES IN A NON-HOMOGENEOUS ELASTIC PLATE WITH A CIRCULAR HOLE D. E. Jones and B. I. Hyman 81 p refs (See N71-24647 13-32)

6. AN OPTIMUM DESIGN FOR THE INSTABILITY OF CYLINDRICAL SHELLS UNDER LATERAL PRESSURE A. W. Lucas, Jr. and B. I. Hyman 56 p refs (See N71-24648 13-32)

N71-24643*# George Washington Univ., Washington, D.C. Engineering Mechanics Dept.
STRESS ANALYSIS OF THIN ELASTO-PLASTIC SHELLS
Barry I. Hyman and Oles Lomacky (Naval Ship Res. and Develop. Center) *In its* Probl. in Stress Analysis and Optimum Design Feb. 1970 49 p refs (See N71-24642 13-32)
Avail: NTIS HC $6.00/MF $0.95 CSCL 20K

The stress analysis of thin shells with large deflections loaded into the strain hardening range is presented. Plastic strain incompressibility is assumed. The two governing differential equations in terms of the stress function and the normal displacement are derived in a form where the corresponding equations of the elastic problem are modified by the addition of the integrals of the plastic strains. The theory is applied to the problem of stress concentration around a circular opening in a pressurized spherical shell. Author

N71-24644*# George Washington Univ., Washington, D.C.
EXPLORATORY TESTS ON FIBER-REINFORCED PLATES WITH CIRCULAR HOLES UNDER TENSION
Barry I. Hyman, A. De Turk, R. Diaz, and G. Di Giovanni *In its* Probl. in Stress Analysis and Optimum Design Feb. 1970 2 p refs Repr. from AIAA J., v. 7, no. 9, Sep. 1969 p 1820–1821 (See N71-24642 13-32)
Copyright. Avail: NTIS HC $6.00/MF $0.95 CSCL 20K

Test results are presented for local stress concentration loads on laminate plates with several fiber arrangements. The effects of holes drilled in composite plates with unidirectional and bidirectional fibers were evaluated, and the feasibility of routing the fibers around the holes during the plate fabrication process instead of drilling holes in the fabricated plate was also studied. Seventeen specimens were cut from plates made of five laminated plies. Three groups of plates were fabricated and tested for each of the two fiber compositions. Author

N71-24645*# George Washington Univ., Washington, D.C. Engineering Mechanics Dept.
THE STRESS-STRAIN RELATIONS FOR A NONHOMOGENEOUS COMPOSITE WITH A CIRCULAR INCLUSION
William Thomas Packard and Barry I. Hyman *In its* Probl. in Stress Analysis and Optimum Design Feb. 1970 62 p refs (See N71-24642 13-32)
Avail: NTIS HC $6.00/MF $0.95 CSCL 20K

The expressions for the elastic coefficients in the generalized Hooke's Law for unilateral and bilateral fiber reinforced composite

plates are presented. These plates each contain a circular inclusion around which the fibers are oriented, so that the composite is anisotropic and nonhomogeneous. The material is assumed to be locally orthotropic, and existing methods are used to obtain elastic coefficients with the directions tangent and perpendicular to the fibers at any point. Coordinate transportations are employed to transform the elastic coefficients of the composite from the local fiber coordinates at a point to a global coordinate system. Equations for the elastic coefficients of a layered plate are obtained by an appropriate weighing of the results for each layer. Author

N71-24646*# George Washington Univ., Washington, D.C. Engineering Mechanics Dept.

EXPERIMENTAL STRESS ANALYSIS OF COMPOSITE PLATES WITH HOLES

Javad Nilforoush and Barry I. Hyman *In its* Probl. in Stress Analysis and Optimum Design Feb. 1970 64 p refs (See N71-24642 13-32)

Avail: NTIS HC $6.00/MF $0.95 CSCL 20K

The fundamentals relating the mechanical properties of the constituents to those of the composite unidirectionally reinforced and loaded were studied at the elastic level. Strength theories based on mathematical theory of elasticity were developed and compared with experimental results. The influence of both fiber and matrix characteristics on deformation and the mechanics of failure was also studied. Analytical techniques for estimating the stresses in composite structures were developed for simple configurations. Author

N71-24647*# George Washington Univ., Washington, D.C. Engineering Mechanics Dept.

STRESSES IN A NONHOMOGENEOUS ELASTIC PLATE WITH A CIRCULAR HOLE

Donald Everett Jones and Barry I. Hyman *In its* Probl. in Stress Analysis and Optimum Design Feb. 1970 81 p refs (See N71-24642 13-32)

Avail: NTIS HC $6.00/MF $0.95 CSCL 20K

A brief background on the use and nature of composite plastics, the elastic theory for the nonhomogeneous plate problem, and computational approach for obtaining a numerical solution for the stress concentration problem using a digital computer are presented. A FORTRAN program for solving the difference equations, and for obtaining numerical values for analytical isotropic solutions and analytical orthotropic solutions are also cited. J.A.M.

N71-24648*# George Washington Univ., Washington, D.C. Engineering Mechanics Dept.

AN OPTIMUM DESIGN FOR THE INSTABILITY OF CYLINDRICAL SHELLS UNDER LATERAL PRESSURE

Arthur W. Lucas, Jr. and Barry I. Hyman *In its* Probl. in Stress Analysis and Optimum Design Feb. 1970 56 p refs (See N71-24642 13-32)

Avail: NTIS HC $6.00/MF $0.95 CSCL 20K

The optimum design against buckling of cylindrical shells subject to external lateral pressure is presented. The optimization procedure is applied to the free geometric parameters obtained by allowing a linear variation of wall thickness in the shell. The optimum configuration of the shell is found by introducing the constraint of constant weight into the expression for the total energy of the system and reducing this expression to a set of nonlinear algebraic equations. The reduction of the energy expression to a set of nonlinear algebraic equations is accomplished by using the Ritz technique to satisfy the condition of stationary potential energy. As a result of applying these concepts to the analysis of a cylindrical shell under external lateral pressure, it was found that significant increases in the buckling pressure can be obtained through optimization of the free geometric parameters. Author

N71-24651*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

NASA SPACE SHUTTLE TECHNOLOGY CONFERENCE. VOLUME 3: DYNAMICS AND AEROELASTICITY

Washington Apr. 1971 448 p refs Conf. held at Langley Station, Va., 2–4 Mar. 1971

(NASA-TM-X-2274; L-7739) Avail: NTIS HC $6.00/MF $0.95 CSCL 20K

CONTENTS:

1. RECENT STUDIES OF SPACE SHUTTLE MULTIBODY DYNAMICS S. A. Leadbetter and L. A. Kiefling p 1–25 ref (See N71-24652 13-32)

2. SPACE SHUTTLE TPS PANEL VIBRATION STUDIES H. D. Carden, B. J. Durling, and W. C. Walton, Jr. p 27–48 refs (See N71-24653 12-32)

3. APPROXIMATE ANALYSIS AND DYNAMIC TESTS FOR A THERMAL PROTECTION SYSTEM PANEL I. U. Ojalvo and N. Arcas (Grumman Aerospace Corp., Bethpage, N.Y.) p 49–93 refs (See N71-24654 13-32)

4. SPACE SHUTTLE LIQUID DYNAMICS F. M. Bugg and N. S. Land p 95–120 (See N71-24655 13-32)

5. SOME LANDING GEAR CONSIDERATIONS FOR SPACE SHUTTLE VEHICLES B. R. Hanks and T. J. W. Leland p 121–154 refs (See N71-24656 13-31)

6. RECENT STUDIES OF EFFECTS OF GROUND WINDS ON SPACE SHUTTLE VEHICLES R. W. Hess, W. H. Reed, III, and J. T. Foughner, Jr. p 155–179 refs (See N71-24657 13-31)

7. EFFECTS OF SPACE SHUTTLE CONFIGURATION ON WING BUFFET AND FLUTTER PART 1: LAUNCH VEHICLE WITH TIP FIN R. C. Goetz p 181–199 refs (See N71-24658 13-31)

8. THICK HIGH ASPECT RATIO WING, PART II L. L. Erickson, B. J. Gambucci, and P. R. Wilcox (NASA. Ames Research Center, Moffett Field, Calif.) p 201–229 refs (See N71-24659 13-32)

9. APPLICATION OF RECENT PANEL FLUTTER RESEARCH TO THE SPACE SHUTTLE. PART 1: BOUNDARY LAYER AND HYPERSONIC EFFECTS P. A. Gaspers, Jr. (NASA. Ames Research Center, Moffett Field, Calif.) p 231–245 refs (See N71-24660 13-32)

10. APPLICATION OF RECENT PANEL FLUTTER RESEARCH TO THE SPACE SHUTTLE. PART II: INFLUENCE OF EDGE CLIPS AND FLOW ANGULARITY H. L. Bohon and C. P. Shore p 247–264 refs (See N71-24661 13-32)

11. BUFFET RESPONSE OF SPACE SHUTTLE LAUNCH CONFIGURATIONS AS DETERMINED BY TESTS OF AN AEROELASTIC MODEL L. Muhlstein, Jr. (NASA. Ames Research Center, Moffett Field, Calif.) p 265–291 (See N71-24662 13-32)

12. PRELIMINARY MEASUREMENTS AND FLOW VISUALIZATION STUDIES OF PRESSURE FLUCTUATIONS ON SPACE SHUTTLE CONFIGURATIONS C. F. Coe, J. B. Dods, Jr., R. C. Robinson, and W. H. Mayes p 293–314 ref (See N71-24663 13-32)

13. THE EFFECTS OF PARAMETER VARIATION ON INFLIGHT WIND LOADING A. C. Mackey (NASA. Manned Spacecraft Center, Houston, Tex.) p 315–332 (See N71-24664 13-32)

14. TECHNOLOGY: PRELIMINARY INVESTIGATION OF LOAD AND MODAL SUPPRESSION FOR SPACE SHUTTLE B. J. Kuchta (Gen. Dyn./Convair, San Diego, Calif.) p 333–357 (See N71-24665 13-32)

15. SHUTTLE POGO REVIEW J. E. Harbison (NASA. Marshall Space Flight Center, Huntsville, Ala.) p 359–399 (See N71-24666 13-31)

16. SPACE SHUTTLE ACOUSTICS S. H. Guest (NASA. Marshall Space Flight Center, Huntsville, Ala.) p 401–422 (See N71-24667 13-31)

17. PRELIMINARY VIBRATION DESIGN AND TEST CRITERIA CONSIDERATIONS FOR THE SPACE SHUTTLE H. J. Bandgren

(NASA. Marshall Space Flight Center, Huntsville, Ala.) p 423-450 ref (See N71-24668 13-32)

N71-24652*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

RECENT STUDIES OF SPACE SHUTTLE MULTIBODY DYNAMICS

Sumner A. Leadbetter and Larry A. Kiefling *In its* NASA Space Shuttle Technol. Conf., Vol. 3 Apr. 1971 p 1-25 ref (See N71-24651 13-32)

Avail: NTIS HC$6.00/MF$0.95 CSCL 20K

The parallel-staged space shuttle vehicle which poses new dynamics problems in addition to those that in the past have been associated with launch vehicles and aircraft was studied. Preliminary results are discussed from vibration studies of a 1/15-scale space shuttle dynamic model to indicate some parametric trends, presents an analytical substructuring technique that will enable handling more complex structures with existing computer capability, and presents some results from a study to improve the mathematical model input data. Author

N71-24653*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SPACE SHUTTLE TPS PANEL VIBRATION STUDIES

Huey D. Carden, Barbara J. Durling, and William C. Walton, Jr. *In its* NASA Space Shuttle Technol. Conf., Vol. 3 Apr. 1971 p 27-48 refs (See N71-24651 13-32)

Avail: NTIS HC$6.00/MF$0.95 CSCL 20K

Preliminary results from the studies of vibrations of panels at room temperature are reported. Two representative metal panels were investigated. The NASTRAN computer program was applied to compute vibration modes of both panels. One of the panels was fabricated and a vibration survey made to determine the natural vibration modes. The objectives and approaches in the analytical modeling, considerations related to computer time to compute the modes, and results and problems arising in an effort to correlate experimentally and analytically determined modes are discussed. Author

N71-24654*# Grumman Aerospace Corp., Bethpage, N.Y.

APPROXIMATE ANALYSIS AND DYNAMIC TESTS FOR A THERMAL PROTECTION SYSTEM PANEL

I. U. Ojalvo and N. Arcas *In* NASA. Langley Res. Center NASA Space Shuttle Technol. Conf., Vol. 3 Apr. 1971 p 49-93 refs (See N71-24651 13-32)

Avail: NTIS HC$6.00/MF$0.95 CSCL 20K

A combined analytical and experimental program to determine the transverse dynamic response of TPS panels for the space shuttle is discussed. The panel is idealized as a pinned-pinned/free-free heated plate with corrugation stiffening and local mass and stiffness attachments. Galerkin's procedure is used to generate an algebraic eigenvalue problem from which natural modes and frequencies are calculated. Approximate modal superposition formulas are then presented to predict RMS strain levels to broad-band acoustic excitation. Tests were performed to measure natural frequencies, mode shapes, damping and response to acoustic excitation. Results of the frequency and damping tests appear reasonable. Although difficulties were encountered with mode shape measurements, it is felt that the results obtained can be useful in predicting approximate panel response to combined acoustic, thermal, and quasi-static pressure loading once critical panel loading conditions are specified. Author

N71-24655*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SPACE SHUTTLE LIQUID DYNAMICS

Frank M. Bugg and Norman S. Land *In its* NASA Space Shuttle Technol. Conf., Vol. 3 Apr. 1971 p 95-120 (See N71-24651 13-32)

Avail: NTIS HC$6.00/MF$0.95 CSCL 20K

Potential propellant dynamics problem areas were studied. The problems considered were: propellant feedline dynamics, effect of bubble location, effect of turbulent flow, and the effect on liquid oscillation frequency of tilting the tank axis relative to the acceleration vector. Computer programs were developed for determining the effects of several factors on propellant dynamics in feedlines, and for determining forces exerted by a propellant on its tank during large amplitude motions. F.O.S.

N71-24656*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

THICK HIGH ASPECT RATIO WING, PART 2

Larry L. Erickson, Bruno J. Gambucci and Phillip R. Wilcox *In its* NASA Space Shuttle Technol. Conf., Vol. 3 Apr. 1971 p 201-229 refs (See N71-24651 13-32)

Avail: NTIS HC$6.00/MF$0.95 CSCL 20K

Transonic flutter and buffet results are presented for two elastic models of a proposed space-shuttle straight wing. The models were tested at Mach numbers from 0.6 to 1.1 at various dynamic pressures and at angles of attack up to 18 deg. Zero degree angle of attack flutter occurred in a narrow Mach number range centered at about Mach 0.85. Stall flutter was not observed although several instances of low torsional damping were noted. At conditions of maximum buffet intensity, model peak dynamic banding moments ranged up to 80% of the corresponding static banding moments. Author

N71-24660*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

APPLICATION OF RECENT PANEL FLUTTER RESEARCH TO THE SPACE SHUTTLE. PART 1: BOUNDARY LAYER AND HYPERSONIC EFFECTS

Peter A. Gaspers, Jr. *In its* NASA Space Shuttle Technol. Conf., Vol. 3 Apr. 1971 p 231-245 refs (See N71-24651 13-32)

Avail: NTIS HC$6.00/MF$0.95 CSCL 20K

Published experimental and theoretical results concerning panel flutter are reviewed and some very recent and very significant theoretical results for large boundary layer thickness are presented. In addition, some theoretical results for panel flutter at hypersonic speeds which show nonlinear destabilizing effects are reviewed. Finally the significance of these results and their application to the space shuttle are discussed. Author

N71-24661*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

APPLICATION OF RECENT PANEL FLUTTER RESEARCH TO THE SPACE SHUTTLE. PART 2: INFLUENCE OF EDGE CLIPS AND FLOW ANGULARITY

Herman L. Bohon and Charles P. Shore *In its* NASA Space Shuttle Technol. Conf., Vol. 3 Apr. 1971 p 247-264 refs (See N71-24651 13-32)

Avail: NTIS HC$6.00/MF$0.95 CSCL 20K

The parameters that are known contributors to aeroelastic problems in light of current TPS designs are examined. In particular, the nature of boundary conditions and flow angularity as they affect panel flutter are discussed. The data are not restricted to metallic panels but, in fact, may also apply to panels with external insulation. Emphasis, however, is placed on the orthotropy of the surface structure and the deflectional flexibility of the clips which connect it to the primary structure. Author

N71-24662*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

BUFFET RESPONSE OF SPACE SHUTTLE LAUNCH

CONFIGURATIONS AS DETERMINED BY TESTS OF AN AEROELASTIC MODEL

Lado Muhlstein, Jr. *In its* NASA Space Shuttle Technol. Conf., Vol. 3 Apr. 1971 p 265–291 (See N71-24651 13-32)

Avail: NTIS HC $6.00/MF $0.95 CSCL 20K

Preliminary results of a series of tests designed to investigate the buffet response of a typical straight wing and a delta wing space shuttle vehicle (SSV) launch configuration recently completed at the Ames Research Center are presented. The purpose of these tests was to determine what are some of the potential buffet problems of a typical SSV launch configuration. Author

N71-24663*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PRELIMINARY MEASUREMENTS AND FLOW VISUALIZATION STUDIES OF PRESSURE FLUCTUATIONS ON SPACE SHUTTLE CONFIGURATIONS

Charles F. Coe, Jules B. Dods, Jr., Robert C. Robinson, and William H. Mayes *In its* NASA Space Shuttle Technol. Conf., Vol. 3 Apr. 1971 p 293–314 ref (See N71-24651 13-32)

Avail: NTIS HC $6.00/MF $0.95 CSCL 20K

Results of research in flow characteristics and pressure fluctuations on space shuttle launch and reentry configurations are reported. The investigations to date have consisted of pressure fluctuation measurements at transonic speeds on 0.01- and 0.025-scale models of straight- and delta-wing launch configurations and fluorescent oil flow tests of 0.008-scale models of straight- and delta-wing launch configurations over a Mach number range of 0.8 to 2.0. The Bolt, Beranek and Newman tests have been directed to the definition of unsteady pressures for reentry conditions. They consisted of flow visualization studies and measurements of pressure fluctuations on both 0.004-scale and 0.0077-scale models of a low-cross-range orbiter configuration at alpha = 60 deg for Mach numbers of 2.5 and 4.0. Author

N71-24664*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

THE EFFECTS OF PARAMETER VARIATION ON INFLIGHT WIND LOADING

Alden C. Mackey *In its* NASA Space Shuttle Technol. Conf., Vol. 3 Apr. 1971 p 315–332 (See N71-24651 13-32)

Avail: NTIS HC $6.00/MF $0.95 CSCL 20/4

Performance, controllability, and structural loads were investigated to maximize the payload in space shuttle operation. The parameters: wing incidence angle, control system gains, commanded attitude history, and winds are considered to affect boost loads and performance. Their effects are presented in graphs. It is concluded that the means for reducing structural loads are available, and structural loading must be considered in payload maximization analyses. F.O.S.

N71-24665*# General Dynamics/Convair, San Diego, Calif. Aerospace Div.

TECHNOLOGY: PRELIMINARY INVESTIGATION OF LOAD AND MODAL SUPPRESSION FOR SPACE SHUTTLE

Bernard J. Kuchta *In* NASA. Langley Res. Center NASA Space Shuttle Technol. Conf., Vol. 3 Apr. 1971 p 333–357 (See N71-24651 13-32)

(Contract NAS9-11191) Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

The potential value of loads alleviation control for space shuttle vehicles was studied: to develop rigid body design load reduction techniques, to determine performance and weight penalties associated with the rigid body load reduction, and to evaluate the need for modal suppression. The configurations studied were the straight wing booster, and the low-crossrange straight wing orbiter. It is shown that orbiter trades for payload in a 1 to 1 ratio, while booster structure trades for payload by approximately 6 to 1. F.O.S.

N71-24668*# National Aeronautics and Space Administration Marshall Space Flight Center, Huntsville, Ala.

PRELIMINARY VIBRATION DESIGN AND TEST CRITERIA CONSIDERATIONS FOR THE SPACE SHUTTLE

Harry J. Bandgren *In its* NASA Space Shuttle Technol. Conf., Vol. 3 Apr. 1971 p 423–450 ref (See N71-24651 13-32)

Avail: NTIS HC $6.00/MF $0.95 CSCL 20K

Some Marshall Space Flight Center preliminary vibration design and test criteria considerations for the space shuttle are presented. The discussion is primarily concerned with the formulation of vibration criteria for the design and testing of the equipment installations on the shuttle. A recommended criteria format is given with a discussion of when the vibration environment has to be considered in design and testing. A semiempirical method of predicting the vibration criteria for the shuttle from vibroacoustic structural data banks is presented with some preliminary vibration criteria predictions for the orbiter and booster equipment bays and for the main shuttle engine. A research testing program to determine the vibroacoustic transfer through a typical shuttle thermal protection system panel configuration is described. Author

N71-24814 North Carolina State Univ., Raleigh.

ANALYSIS OF TRUSS REINFORCED PLATES BY DISCRETE FIELD THEORY

Maurice Cornelius Todd (Ph.D. Thesis) 1969 111 p

Avail: Univ. Microfilms Order No. 70-9240

The problem of two identical plates reinforced by X-braced trusses and loaded by general anti-symmetrical and symmetrical loadings is solved. Only the coupling effects of in-plane forces and out-of-plane deformations have been neglected. The plates are assumed to be simply supported for both in-plane and out-of-plane deformations. The trusses are assumed to have zero out-of-plane deflections at the boundaries and zero displacements parallel to the edges at the bounderies. These boundary conditions which are satisfied exactly are quite practical, for example, in a roof-ceiling configuration with shear panels on the boundaries. Expressions for the nodal quantities, displacements and interaction forces, are obtained in finite trigonometric series while the continuous span displacements and bending moments are given by infinite trigonometric series. Dissert. Abstr.

N71-24816 Rensselaer Polytechnic Inst., Troy, N.Y.

ON THE PROPAGATION OF WAVES IN AN INFINITE ELASTIC PLATE IN CONTACT WITH AN INVISCID LIQUID

Wayne West Walter (Ph.D. Thesis) 1969 145 p

Avail: Univ. Microfilms Order No. 70-11332

The propagation of waves in an infinite isotropic elastic plate covered by an inviscid incompressible liquid of finite depth is discussed. The regions above the free surface of the liquid and below the lower surface of the plate are assumed vacuous. It is assumed that the motion of the plate is described by the plane strain form of the equations of linear elasticity. The dispersion equation is developed. In order to facilitate the numerical evaluation of this equation, the limiting cases of very long and very short wavelengths are considered. For long wavelengths, the dispersion equation reduces to that for thickness-stretch motion, and for very short wavelenths, it reduces to that for the Rayleigh problem, that is, for Rayleigh surface waves at the solid liquid interface. Analyses of the thickness-stretch motion and the Rayleigh problem are presented. Dissert. Abstr.

N71-24817 Cornell Univ., Ithaca, N.Y.

VARIATIONAL AND DISPLACEMENT BOUNDING PRINCIPLES IN FINITELY DEFORMING PLASTIC STRUCTURES

John F. Soechting (Ph.D. Thesis) 1969 47 p

Avail: Univ. Microfilms Order No. 70-8022

An absolute minimum principle and a deformation bounding theorem for finitely deforming, rigid-plastic structures exhibiting

geometric stability are developed. The general three-dimensional problem is formulated in terms of Kirchhoff's stress tensor and Green's strain tensor and the usual assumptions of plasticity are made. The minimum principle is formulated for work-hardening continua and possible applications are discussed. The deformation bounding principle for perfectly plastic structures is constructed by making use of the principle of virtual work and Drucker's postulate. The theorem is applied to find a bound on the response of a simply-supported cylindrical shell under internal pressure. The exact solution to this problem is also found and the results are compared.
Dissert. Abstr.

N71-24820*# Southwest Research Inst., San Antonio, Tex.
EXPERIMENTAL STUDY OF PLASTIC YIELDING AT THE TIP OF SURFACE FLAW CRACKS Final Report, 14 May 1969–30 May 1971
P. H. Francis, D. L. Davidson, H. C. Burghard, and A. Nagy May 1971 117 p refs
(Contract NAS9-9493)
(NASA-CR-114934) Avail: NTIS CSCL 20K

An experimental investigation was undertaken to determine the stability, surface deformation characteristics, and extent of plastic yielding associated with semielliptical surface cracks in plates subjected to tensile loading. The experiments involved both Fe-3Si and Ti-6Al-4V specimens, and a wide range of crack geometries and applied loads were included in the test matrix. Following load tests the Fe-3Si specimens were subjected to an electrolytic etching treatment to reveal the plastic zones in various planes intersecting the crack. Available analytical models of yield zone size and stress intensity factor were used to correlate the data.
Author

N71-24845# Syracuse Univ. Research Corp., N.Y. Materials Science Lab.
THE EFFECT OF STRESS FIELDS ON THE ULTRASONIC ENERGY REFLECTED FROM DISCONTINUITIES IN SOLIDS Quarterly Progress Report, 28 Oct. 1970–28 Jan. 1971
John G. Sessler 28 Jan. 1971 10 p refs
(Contract N00600-71-C-0581; ARPA Order 1243)
(AD-719434; QPR-1) Avail: NTIS CSCL 14/2

The challenge to the field of nondestructive testing (NDT) is to develop procedures capable of resolving defects of critical size and to accurately define defect geometry. The NDT research program now in progress under the contract is a modification of the ultrasonic pulse-echo method of flaw detection. The approach is based on the principal that when a stress field is applied to a discontinuity (defect or flaw) in a solid, a change in the geometry of the discontinuity is effected. The change in geometry can result in corresponding changes in amplitude and/or pattern of ultrasonic energy reflected from the discontinuity. It is reasonable to expect that the reflected energy response should be relatable to specific distinguishing features of a given type of discontinuity.
Author (GRA)

N71-24849# Japan Atomic Energy Research Inst., Tokyo.
NONDESTRUCTIVE TESTING OF AIRCRAFT STRUCTURES BY RADIOISOTOPES
Oct. 1970 153 p refs In JAPANESE; ENGLISH summary
(JAERI-Memo-4163) Avail: AEC Depository Libraries

The preparation and radiological characteristics of Tm-170 and Ir-192 gamma sources, and the nondestructive testing of structural parts for aircraft using gamma sources, are discussed.
Author (NSA)

N71-25108 Virginia Polytechnic Inst., Blacksburg.
GENERAL NONLINEAR PLATE THEORY APPLIED TO A CIRCULAR PLATE WITH LARGE DEFLECTIONS
George Junkin, II (Ph.D. Thesis) 1970 109 p
Avail: Univ. Microfilms Order No. 70-9914

The general nonlinear first approximation thin plate tensor equations in undeformed coordinates valid for large strains, rotations and displacements are developed based on the single assumption of plane stress. These equations are then reduced to the exact tensor and physical component equations for symmetrical circular plates. An order of magnitude analysis is performed on the resulting equations which shows that they reduce to the classical linear equations for very small deflections and to the von Karman equations for moderate deflections. However, the equations do not reduce to the Reissner equations for large deflections. The solution to the problem of a clamped circular plate loaded with a concentrated load on a central rigid inclusion was obtained and agreed with the solution of von Karman's equations for moderate deflections.
Dissert. Abstr.

N71-25120*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMAL FATIGUE TESTING OF SIMULATED TURBINE BLADES
D. A. Spera, F. D. Calfo, and P. T. Bizon [1971] 16 p refs Presented at the Natl. Air Transportation Meeting, Atlanta, 10–13 May 1971; sponsored by SAE
Avail: NTIS CSCL 21E

Thermal fatigue data on simulated turbine blades to be used in evaluating life prediction theories are presented. The ability to predict the thermal fatigue performance of an engine component from its shape, material, environment, and loading is discussed. Three tests for providing data are: (1) isothermal tests such as tensile, creep-rupture, and low cycle fatigue, (2) thermal fatigue tests on simple wedge specimens using the fluidized bed technique, and (3) burner rig tests on simulated turbine blades, with and without cooling. Data on uncooled blades from the burner rig test series are presented.
Author

N71-25121 Cornell Univ., Ithaca, N.Y.
NUMERICAL SOLUTIONS OF FIBER-MATRIX BOND STRESSES IN COMPOSITES
William Wei-ling Chu (Ph.D. Thesis) 1969 195 p
Avail: Univ. Microfilms Order No. 70-8662

Theoretical elasticity solutions are presented for determining the bond stresses in multifiber composite materials due to uniform tension. The theoretical analysis is based on the superposition of the solution of a point-force in a two-dimensional space. A modified point matching method is employed to satisfy boundary conditions at a dense set of boundary points. The analysis is first applied to a uniaxially stressed elastic sheet in which a single rigid, one-dimensional fiber is embedded in the direction of the loading. By superposition, the analysis is then extended to the case where the elastic sheet is reinforced by rows and columns of overlapping fibers. The bond stresses along the interface are found for various spacing dimensions. In addition, the interference of the highly stressed fiber ends is investigated and the dependence on the degree of overlap is discussed.
Dissert. Abstr.

N71-25126 Lehigh Univ., Bethlehem, Pa.
MIXED BOUNDARY VALUE PROBLEMS IN AXIALLY SYMMETRIC LAYERED MEDIA
Kemal Arin (Ph.D. Thesis) 1969 148 p
Avail: Univ. Microfilms Order No. 70-10583

Several axially symmetric mixed boundary value problems in elastic dissimilar layered media are considered. It is assumed that the composites may have imperfections which are idealized to be penny-shaped cracks lying either on or parallel to the interfaces, the latter being in the layer. Using some integral representations for the Papkovich–Neuber functions, the mixed boundary conditions are first reduced to a system of dual integral equations, and then, by a systematic approach, to a system of singular integral equations. Finally, by approximate techniques, the resulting systems are solved.

In the numerical examples, such physically important quantities as stress intensity factors and strain energy release rates for different geometries are obtained and plotted. A detailed discussion of the results is given. Dissert. Abstr.

N71-25127# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRENGTH STABILITY VIBRATIONS, VOLUME 2
A. Ya. Aleksandrov et al 18 Dec. 1970 536 p refs Transl. into ENGLISH of the book "Prochnost Ustoichivost Kolebaniya" USSR, 1968 p 1–463
(AD-719777; FTD-HC-23-598-69) Avail: NTIS HC $6.00/MF $0.95 CSCL 20/11

This is the second volume of a 3-volume handbook edited by I. A. Birger, Doctor of Technical Sciences and Ya. G. Panvoko, Corresponding Member, Academy of Sciences, Latvian SSR. The methods of designing for strength thin composite, anisotropic, and sandwich plates and shells and those made of reinforced and oriented glass-reinforced polymeric materials are presented, as well as analyses of stress and strain in thick-walled cylinders and on contact surfaces of solids. Author (GRA)

N71-25132 Stanford Univ., Calif.
INITIAL SPEEDS OF ELASTIC-PLASTIC BOUNDARIES IN THE PROPAGATION OF PLANE PRESSURE-SHEAR WAVES IN A HALF-SPACE
Devendra Singh Chhabra (Ph.D. Thesis) 1970 77 p
Avail: Univ. Microfilms Order No. 70-10438

The boundary value problem to be solved for elastic-plastic wave propagation due to combined pressure and shear loading on the surface of a half-space involves an a priori unknown number of elastic and plastic regions with unknown and moving boundaries. The solution in each region is to be obtained by using the appropriate set of equations. In order to obtain a solution of the problem formulated for general time-dependent pressure and shear stresses, one has to resort to some numerical scheme. The standard numerical approach, based upon the method of characteristics, requires a starting solution. The elastic-plastic boundaries as they start at the free-surface of the half-space, are studied. The material is assumed to be a homogeneous, isotropic, elastic-plastic continuum that obeys von Mises yield criterion. The applied stresses on the surface are assumed to be continuous but discontinuities are allowed to occur in their time derivatives. Analytical solutions are obtained for the initial speeds of the elastic-plastic boundaries generated at the surface of the half-space. All possible combinations of time derivatives of stresses before and after the elastic-plastic boundaries are generated, are considered. It is seen that there are twelve possible cases depending on the values of the stresses, their derivatives, and the initial conditions. The necessary and sufficient conditions for each case are obtained in the forms of inequalities involving the given stresses and the discontinuities in their time derivatives. Dissert. Abstr.

N71-25141# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
AN APPLICATION OF FRACTURE CONCEPTS TO THE PREDICTION OF CRITICAL LENGTH OF FATIGUE CRACKS. PART 1: A REVIEW OF PERTINENT ASPECTS OF FRACTURE. DEVELOPMENT OF RELEVANT CONCEPTS OF LINEAR ELASTIC FRACTURE MECHANICS Technical Report, Jun. 1969–Jun. 1970
Sidney O. Davis (M.S. Thesis) Jan. 1971 82 p refs
(AD-719757; AFML-TR-70-202-Pt-1) Avail: NTIS CSCL 20/11

The purpose of this report is to synthesize technological concepts of fracture by making a historical review of the literature from 1913 up to the present time. The pertinent aspects of fracture and the development of relevant concepts of linear elastic fracture mechanics derivatives were delineated and summarized for the prediction of the critical length of fatigue cracks. The pertinent aspects of fracture consisted of the synthesis of Ingliss, Griffith, Orowan, Irwin, and Westergaards relevant theoretical concepts. It also delineates Boyles analytical and experimental results of the Westergaard-Irwin theoretical compliance of through-the-thickness centrally cracked plate and sheet for the determination of plane-strain and plane-stress fracture toughness stress-intensity parameter of high strength alloys. Author (GRA)

N71-25307*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE NASA STRUCTURAL ANALYSIS GENERAL PURPOSE DIGITAL COMPUTER PROGRAM
Thomas G. Butler *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 221–224 (See N71-25256 13-34)
Avail: NTIS HC $6.00/MF $0.95 CSCL 20K

Applications of the structural analysis program in stress and thermal deformation analyses on structures having varied materials, and for vibrational analysis on multiple connected structures are reported. An example calculation for the Planetary Explorer Spacecraft is given; the critical factor in this design is weight. The distribution of the static load path is determined and subsequently applied to the sizing of individual members for strengths. Satisfaction of these two stress conditions produces a weight reduction. The thermal problem associated with the design is corrected by adjusting variations in mechanical properties of structural members. The vibration analysis uses a representation of the elastic characteristics of the structure to obtain a fine mesh model of its mass properties for antivibratory redistributions. G.G.

N71-25352# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE STABILITY OF CONICAL SHELLS UNDER DYNAMICAL LONGITUDINAL COMPRESSION
M. A. Shumik [1971] 4 p refs Transl. into ENGLISH from Prikl. Mekh., Akad. Nauk Ukr. RSR (Kiev), v. 6, no. 11, 1971 p 122–126
(AD-719851) Avail: NTIS CSCL 20/11

The stability of thin conical shells subjected to dynamical longitudinal compression is investigated. A similar problem was examined in the paper by Sal' Nikov, in which equations of motion were obtained on the basis of the theory of local stability which agreed with the equations of cylindrical shells with a fictitious radius. On this basis, the deductions made for cylindrical shells are extended to conical shells in the paper by Sal' Nikov. However, in the general case the behavior of conical shells under dynamical longitudinal compression has a number of peculiarities, as is shown. Author (GRA)

N71-25380* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STRAIN COUPLED SERVO CONTROL SYSTEM Patent
John H. Crews, Jr. and William T. Davis, inventors (to NASA) Issued 15 Dec. 1970 (Filed 19 Mar. 1969) 4 p Cl. 73-90; Int. Cl. G01c5/30; Int. Cl. G01n3/10
(NASA-Case-XLA-08530; US-Patent-3,546,931; US-Patent-Appl-SN-808577) Avail: US Patent Office CSCL 20K

A system for measuring the local stresses in a material at a geometric discontinuity that are caused by stresses applied to the material is reported. A first servo system applies stresses to a first material specimen with a geometric discontinuity therein. A second servo system applies stresses to a second material specimen to produce strains in the second specimen that are equal to the strains produced at the geometric discontinuity of the first specimen. The strains produced in the second specimen are interpreted as the local stresses at the geometric discontinuity. Official Gazette of the U.S. Patent Office

N71-25381 Virginia Polytechnic Inst., Blacksburg.
SHELLS WITH SUPPRESSED BENDING: STATIC

BEHAVIOR AND STABILITY
Yen Wu (Ph.D. Thesis) 1969 101 p
Avail: Univ. Microfilms Order No. 70-9920

The variation of thickness that is required to suppress bending in shells of revolution loaded with internal or external pressure is determined. It has been found that the ratio of the maximum stress to the minimum stress is 1.24 for an ellipsoid of revolution where the ratio of the equatorial to polar axes is k = 0.8 and nu = 0.3. It has also been found that the weight saving of this type of ellipsoid of revolution is 30 per cent, as compared to the ellipsoid of revolution with constant thickness. Bending suppression is also possible for a dome with clamped edge and for a head of a cylindrical pressure vessel. For these problems, an effort was made to minimize the variation of stress along the meridian in order to have as efficient a structure as possible. Dissert. Abstr.

N71-25362*# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
PERTURBATION AND HARMONIC BALANCE METHODS FOR NONLINEAR PANEL FLUTTER Technical Report, 11 Dec. 1969 – 15 Mar. 1971
Luigi Morino, Ching-Chiang Kuo, and John Dugundji Mar. 1971 107 p refs
(Grant NGR-22-009-387)
(NASA-CR-111907; ASRL-TR-164-1) Avail: NTIS CSCL 20K

Nonlinear panel flutter is examined by using the multiple time scaling method and the harmonic balance method. The two methods are applied to the analysis of: (1) simply supported two dimensional plates; and (2) clamped-clamped three dimensional plates. The effect of mass ratio and inplane loadings are analyzed in both bases. The influence of the aspect ratio is considered also for the three dimensional plate. The two methods yield very similar results. A comparison with existing methods shows that the results are in very good agreement with those obtained by straightforward direct numerical integration method. Author

N71-25363# Lockheed Missiles and Space Co., Sunnyvale, Calif.
EXPERIMENTAL INVESTIGATION OF THE VIBRATIONS OF ELLIPSOIDAL SHELL CONTAINING FLUID
V. I. Borisenko et al 1971 4 p ref Transl. into ENGLISH from Prikl. Mekhan. (USSR), v. 6, no. 11, 1970 p 118–121
(AD-719845) Avail: NTIS CSCL 13/13

The researches performed permit some deductions relative to the effect of fluid content on the vibration frequencies of ellipsoidal shells of revolution. Author (GRA)

N71-25398# Washington Univ., Seattle. Dept. of Mechanical Engineering.
AN INVESTIGATION ON THE CRACK ARREST CAPABILITY OF A HOLE
A. S. Kobayashi, B. G. Wade, and D. E. Maiden Jan. 1971 27 p refs
(Contract N00014-67-A-0103-0018)
(AD-719934; TR-11) Avail: NTIS CSCL 20/11

Dynamic photoelasticity by a 16-spark gap Cranz-Schardin camera system was used to determine some of the conditions leading to fracture arrest by a circular hole ahead of a propagating crack. Photoelastic models of 3/8 in. x 10 in. x 10 in. Homolite-100 plates with a 1/2 inch edge crack were loaded in a fixed grip configuration and crack arrest was achieved by central holes of 1/2, 1/4, and 1/8 inch diameters. For a uniformly loaded plate, with a central hole of 1/8 inch diameter, the propagating crack continued through this hole. Changes in dynamic stress intensity factors, as the crack tip approaches the hole, as well as changes in the dynamic stress concentration factors at the far side of the hole were studied and these results were compared with the corresponding static results determined by finite element analysis. This comparison shows that the static analysis can be used to qualitatively assess the arrest capability of the hole using the maximum static stress concept or the proposed concept of strain energy released as the crack penetrates the hole. Author (GRA)

N71-25400 Lehigh Univ., Bethlehem, Pa.
A SCALING STUDY OF THE PROPAGATION OF PLASTIC STRAIN
Thomas Frank Ammirati (Ph.D. Thesis) 1969 112 p
Avail: Univ. Microfilms Order No. 70-10581

Plastic strain waves were produced in 1/4 in. diameter lead bars by means of a reflected shock wave technique. This reproduces, on a smaller scale, earlier work done on 1 in. diameter lead bars. Comparing the two sets of results shows that, when radial strain is plotted against the position along the bar length, both sets of strain results agree within error for various times. When the strains for the 1/4 in. and 1 in. diameter bars are compared against scaled positions along the bar, for scaled times, the results do not agree. The three-dimensional equations governing the propagation of plastic strain are stated. It is shown that with the proper assumptions, Shea's one-dimensional constitutive relation can be obtained, and that the lateral inertia term is a natural consequence of the radial equation of motion. A dimensional analysis is performed on the general equations. If no time-dependent material property is included in the constitutive relation, the analysis predicts that radial strain vs. time profiles will scale with bar diameter. On the other hand, if such a property is included, scaling will not occur. Dissert. Abstr.

N71-25413*# New York Univ., N.Y. Dept. of Aeronautics and Astronautics.
BUCKLING OF CONTINUOUSLY SUPPORTED BEAMS
G. K. Narasimha Murthy Sep. 1970 45 p refs
(Grant NGL-33-016-067)
(NASA-CR-118313; S-70-7; NYU-AA-70-27) Avail: NTIS CSCL 13M

The buckling of continuously supported infinite beams is investigated. The foundation models used are: the Winkler model, the Pasternak model, and the elastic continuum. For each foundation model, the buckling loads were determined when the beam rests on a two-dimensional foundation and also when the foundation extends beyond the width of the beam. The effect of the outside foundation is established by comparing the obtained buckling loads. Author

N71-25414# Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.
DESIGN DATA ON BUCKLING OF SIMPLY SUPPORTED SKEW PLATES (OBLIQUE COMPONENTS). PART 1: INDIVIDUAL LOADING
Mahabaliraja and S. Durvasula Mar. 1971 63 p refs
(AE-294-S-Pt-1) Avail: NTIS

Buckling of simply supported skew plates under individual loading is considered with the stresses expressed in terms of oblique components. The analysis is based on the Rayleigh - Ritz method with the deflection expressed in terms of a double Fourier series of sine functions. Numerical results for the buckling coefficients for the three types of loading where each one is acting individually are presented in the form of tables and design curves for a wide range of combinations of side ratio and skew angle. Author

N71-25444 Lehigh Univ., Bethlehem, Pa.
ANISOTROPY OF FATIGUE CRACK PROPAGATION IN HOT ROLLED BANDED STEEL PLATE
Francis A. Heiser (Ph.D. Thesis) 1969 119 p
Avail: Univ. Microfilms Order No. 70-10603

The anisotropy of fatigue crack propagation in hot rolled steel plate was studied for three orientations relative to the rolling

direction, viz., crack arrester, crack divider, and short transverse. By controlling the heat treatment it was possible to modify the banded pearlite-ferrite microstructure to develop the following structures: pearlite-ferrite (homogenized), martensite (tempered)-ferrite (banded), and martensite (tempered)-ferrite (homogenized). These structures exhibited a range of mechanical properties, with the tensile strength varying from 70 to 200 ksi and the yield strength from 50 to 150 ksi. The fatigue crack growth rate data were interpreted in fracture mechanics concepts. The dependence of crack growth rate on stress intensity factor was shown to be sensitive to the microconstituents present and their orientation relative to the fracture plane and direction. Generally, crack growth rate dependence on stress intensity range increased as the material toughness decreased and when the fibering was oriented parallel to the fracture plane and direction. Dissert. Abstr.

N71-25445# Bettis Atomic Power Lab., Pittsburgh, Pa.
A FRACTOGRAPHIC STUDY OF ZIRCALOY-4 WEDGE OPENING LOAD PLANE STRAIN SPECIMENS
S. J. Goldberg Dec. 1970 24 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-936) Avail: NTIS

An investigation of the fracture behavior of four unirradiated wedge opening load (WOL) plane-strain Zircaloy-4 samples was performed utilizing both electron fractography and optical metallography. Hydrided and unhydrided specimens were fractured in Mode I (tensile component of stress applied normal to crack face) at 100 and 175 F. It was found that the unhydrided samples failed predominantly by microvoid coalescence, whereas the hydrided specimens fractured primarily by cleavage and quasi-cleavage mechanisms. In both cases the fracture characteristic was more intergranular than transgranular. It was also noted that increasing amounts of hydrogen tended to minimize local surface variations in the mode of fracture. Because most of the fracture was intergranular and the hydrides appear at the grain boundaries, it is believed that much of the observed cleavage is through the hydrides rather than in the Zircaloy. Author (NSA)

N71-25448# Research Inst. of National Defence, Stockholm (Sweden). Dept. of Electronics.
CORRELATOR AND SQUARE LAW DETECTOR SYSTEMS, S/N AND DIRECTIONAL CHARACTERISTICS: BEARING ACCURACY. PART 2: THE CORRELATION DETECTOR
L. Goetherstroem Aug. 1969 96 p refs
(FOA-3-C-3580-57) Avail: NTIS

The signal to noise and directional characteristics are computed for a number of plane circular symmetric arrays used for the detection of Gaussian signals in Gaussian spherically or cylindrically isotropic noise. Three different detection cases are studied: (1) single source, (2) two sources, and (3) two-way propagation - single source. The accuracy of bearing estimates is treated showing the relative importance of noise, multipath and (slow) signal amplitude fluctuations as causes of bearing instability. The influence of prewhitening, Eckart and Knapp filtering on bearing accuracy is also studied. The results show that the time-varying multipath effects may give the main contribution to the bearing errors. They are causing lobe distortion and fluctuations in the detector output. Author

N71-25449# Advisory Group for Aerospace Research and Development, Paris (France).
COOPERATIVE CREEP TESTING PROGRAMME
D. Coutsouradis (Centre Natl. de Rech. Met.) and D. K. Faurschou (Dept. of Energy, Mines and Resources) Mar. 1971 100 p refs
(AGARD-R-581-71) Avail: NTIS

The Advisory Group for Aerospace Research and Development (AGARD) initiated an interlaboratory study of high-temperature creep-testing facilities and techniques. The program utilised factorial design and analysis. Nimonic-105 was tested at 900 C by eighteen voluntary laboratories. The results have permitted statistical evaluation of intra and interlaboratory variability and the significance of some testing and material variables which affect creep results. Author

N71-25536# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
PLASTIC STABILITY OF ARCHES: RECONSIDERATION OF A MODEL
Steven C. Batterman (Pennsylvania Univ.) Jan. 1971 30 p refs Sponsored in part by NSF
(TAE-119) Avail: Issuing Activity

A model for plastic buckling of three hinged arches is discussed. Calculations are presented for the idealized geometrically perfect structure and for realistic imperfect structures. The linear work-hardening material stress-strain behavior accounts for reverse plastic flow in tension and its effect on load-deflection behavior. For the perfect system it is shown that, in contradistinction to the basic column problem, the asymptotes to the load-deflection curve are functions of the load at which bifurcation begins. For the imperfect system it is shown that as the imperfection parameter approaches zero the arch does not exhibit asymmetric bifurcation as previously thought. Attention is directed at the implications of the analysis towards the founding of a general theory of plastic stability. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N71-24383# Air Force Systems Command, Edwards AFB, Calif. Air Force Rocket Propulsion Lab.
DROPLET EVAPORATION IN THE LIQUID VAPOR CRITICAL REGION Technical Report, Sep. 1968–Jan. 1969
Franklin B. Mead, Jr. Dec. 1970 35 p refs
(AD-718968; AFRPL-TR-70-140) Avail: NTIS CSCL 7/4

A discussion of the development of thermodynamic theory relative to critical point phenomena is presented, and the critical region is defined based upon the anomalous behavior of various physical properties. The behavior in the critical region of certain thermodynamic parameters used extensively in theories that describe the evaporation process is illustrated. Recent data and relevant theories are discussed, and a qualitative description of droplet evaporation is formulated. Author (GRA)

N71-24372# National Physical Lab., Teddington (England). Div. of Chemical Standards.
THE THERMODYNAMIC PROPERTIES OF DOUBLE OXIDES
O. Kubaschewski Nov. 1970 32 p refs
(NPL-DCS-7) Copyright. Avail: NTIS

The properties of double oxides are dealt with except carbonates, silicates, and borates which will be considered later. The thermodynamic properties of double oxides are of practical importance for the assessment of slag-metal equilibria, refining of metals, and metal-refractory interactions and should eventually assist in the evaluation of equilibrium diagrams. Author (ESRO)

N71-24446# Glasgow Univ. (Scotland). Dept. of Aeronautics and Fluid Mechanics.
THE ROLE OF HEAT CONDUCTION IN LEADING EDGE HEATING THEORY AND EXPERIMENT

T. R. F. Nonweiler, H. Y. Wong, and S. R. Aggarwal London Aeron. Res. Council 1970 52 p refs Supersedes ARC-31445
(Contract PD/48/09/ADM)
(ARC-CP-1126; ARC-31445) Copyright. Avail: NTIS; HMSO: 75p; BIS: $3.00

The effect of heat conduction of material on the temperature distribution in the vicinity of a wing leading edge in hypersonic flight is investigated. The theory is based on a conducting plate subjected to aerodynamic heating. It is found that the role played by the conductivity of the material and the leading edge thickness in moderating the nose temperature is very significant. Detailed discussions of the numerical solutions for various shapes of leading edge are given. An experimental technique has been developed by which a number of models representing a wing leading edge can be tested and the results thus obtained are compared with those predicted by the theory. Author (ESRO)

N71-24512*# Battelle Memorial Inst., Columbus, Ohio.
ACHIEVING UNIFORM SPECIMEN TEMPERATURES IN AN IRRADIATION CAPSULE USING HEAT PIPES
W. J. Zielenbach and N. E. Miller *In* NASA. Lewis Res. Center Natl. Symp. on Develop. in Irradiation Testing Technol. 1969 p 157–164 (See N71-24501 13-22)
(Contract W-7405-eng-92)
Avail: NTIS HC$9.00/MF$0.95 CSCL 20M

Results of laboratory studies indicate that a lithium-filled annular heat pipe is feasible as a means of obtaining near isothermal conditions axially along the surface on the cladding of a short fuel sample in an in-pile fuel-irradiation capsule. At a 1500 C operating temperature the axial spread of temperatures was less than 20 C along a three inch length in an experiment simulating the irradiation capsule. The annular heat pipe would be incorporated into the current capsule configuration employed in the high-temperature-fuels program to achieve uniform specimen cladding temperatures of 1600 to 1900 C. Author (NSA)

N71-24815*# Techtran Corp., Glen Burnie, Md.
HEAT CONDUCTIVITY OF AQUEOUS SOLUTIONS OF ELECTROLYTES [TEPLOPROVODNOST VODNYKH RASTVOROV ELEKTROLITOV]
A. M. Kerimov et al. Washington NASA May 1971 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Mat. i Tekhn. Nauk (Baku), no. 6, 1969 p 112–116
(Contract NASw-2037)
(NASA-TT-F-13660) Avail: NTIS CSCL 20M

An experimental apparatus was constructed using the relative method of a cylindrical layer to determine the heat conductivity of aqueous solutions of electrolytes at high temperatures and pressures. Study of the influence of the dissolved substance on the heat conductivity of the water was also investigated. It was determined that the use of concentric metal containers has numerous advantages over the use of glass in measuring heat conductivity of aqueous salt solutions. Data for experiments with potassium bromide are presented. E.M.C.

N71-24886* Chrysler Corp., Detroit, Mich.
CERAMIC INSULATION FOR RADIANT HEATING ENVIRONMENTS AND METHOD OF PREPARING THE SAME Patent
Vaughn F. Seitzinger and Robert W. Allen, inventors (to NASA) Issued 29 Dec. 1970 (Filed 1 Mar. 1968) 8 p Cl. 161-69; Int. Cl. B32b19/08, 3/10 Sponsored by NASA
(NASA-Case-MFS-14253; US-Patent-3,551,266; US-Patent-Appl-SN-709622) Avail: US Patent Office CSCL 20M

An unfired ceramic insulation is discussed containing finely divided potassium titanate, asbestos, and alumina-silica refractory fibers in a gelled silica sol binder. The insulation is prepared by acidifying a silica sol, mixing the sol with the remaining components, applying the mixture to a substrate, and curing. Migration of the binder during curing is prevented by acidification of the silica sol. Official Gazette of the U.S. Patent Office

N71-24886*# TRW Systems Group, Redondo Beach, Calif. Materials Science Dept.
HEAT AND MASS TRANSFER IN THE VICINITY OF THE VAPOR-GAS FRONT IN A GAS LOADED HEAT PIPE
D. K. Edwards and B. D. Marcus Jan. 1971 36 p refs
(Contract NAS2-5503)
(NASA-CR-114300) Avail: NTIS CSCL 20M

An analysis is presented of axially conducting gas controlled heat pipes leading to a predictive capability for the heat and mass transfer along the heat pipe. In particular, it was found that axial heat conduction is of much greater importance than axial mass diffusion in establishing the wall temperature profiles and condenser heat transfer characteristics of gas loaded heat pipes. However, mass diffusion and, consequently, the choice of working fluid and control gas are of considerable importance in establishing the diffusion freezeout rate if the potential exists for freezing of vapor which penetrates the gas-blocked portion of the condenser. It is believed that the analysis and associated computer program are useful tools for designing gas loaded heat pipes. Author

N71-24876* North American Aviation, Inc., El Segundo, Calif.
METHOD AND APPARATUS FOR VARYING THERMAL CONDUCTIVITY Patent
Jay G. Lindberg, inventor (to NASA) Issued 6 Sep. 1966 (Filed 10 Jan. 1963) 13 p Cl. 165-2 Sponsored by NASA
(NASA-Case-XNP-05524; US-Patent-3,270,802; US-Patent-Appl-SN-250867) Avail: US Patent Office CSCL 20M

A means and apparatus for sensing a temperature linked to heat flow are discussed. The temperature of the apparatus is sensed and the pressure of the gas in the insulation is biased in response to the temperature sensed. The system also has a pressure regulator that is responsive to the pressure of the gas in the insulation material and the temperature in the apparatus. This arrangement provides a closed loop temperature regulator as well as a closed loop pressure control.
Official Gazette of the U.S. Patent Office

N71-24886*# TRW Systems Group, Redondo Beach, Calif.
STEADY STATE AND TRANSIENT PERFORMANCE OF HOT RESERVOIR GAS CONTROLLED HEAT PIPES
B. D. Marcus and G. L. Fleischman [1970] 30 p refs
(Contract NAS2-5503)
(NASA-CR-73420) Avail: NTIS CSCL 20M

The steady state and transient performance of reservoir heat pipes in a hot reservoir system are discussed. Inert gas, in either liquid or vapor form, is used to passively control the heat output from a condenser. The non-condensibles of the gas act as a plug for the condenser as it fills, thus regulating the heat transfer from the system. E.H.W.

N71-24933*# National Aeronautics and Space Administration. Washington, D.C.
DEFORMATION OF DROPS IN THE REACTIVE ZONE DURING HETEROGENEOUS DETONATION [O DEFORMATSII KAPELV V ZONE REAKTSII PRI GETEROGENNOY DETONATSII]
A. A. Borisov et al. May 1971 11 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 5, Sep.–Oct. 1970 p 39–44
(NASA-TT-F-13679) Avail: NTIS CSCL 21B

An analysis is made of the influence of drop formation and deformation processes on the extent of the reaction zone during heterogeneous detonation. It is assumed that a one-dimensional planar detonation wave propagates through a two-phase medium consisting of a gaseous oxidizer and evenly distributed drops of

liquid fuel. The movement of the two-phase mixture is analyzed in a system of coordinates coupled to the leading edge of the wave. The continuity equation for the mixture is derived along with the equations for conservation of momentum and energy. In addition, a system of equations is obtained which includes the equation for drop formation, and the equations of motion and loss of drop volume in dimensionless form. Solution of the system of equations was performed by the method of finite differences. The results of the numerical calculations are presented and their significance is discussed. D.L.G.

N71-24971# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE PROBLEM OF CALCULATING WALL TEMPERATURE IN THE PRESENCE OF CHEMICAL REACTIONS ON THE HEAT TRANSFER SURFACE

V. S. Butko 12 Nov. 1970 10 p refs Transl. into ENGLISH from Energ. Mashinostr. (Kharkov), no. 5, 1967 p 20–23 (AD-719785; FTD-HT-23-548-70) Avail: NTIS CSCL 21/2

The problem of calculating the wall temperature in the presence of chemical reactions is treated by considering the heat transfer between a thermally dissociated gaseous medium and a cooling fluid which are separated by a two-layer wall. The effect of dissociation on the temperature of the heat transfer surface is demonstrated by assuming that given heat transfer coefficients are constant. Author (GRA)

N71-25089*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

INTEGRATION OF THE THREE DIMENSIONAL HEAT CONDUCTION EQUATION

I. Harris May 1971 32 p refs Submitted for publication (NASA-TM-X-65522; X-641-71-164) Avail: NTIS CSCL 20M

The steady state heat conduction equation representing the diurnal variations in the upper atmosphere are numerically integrated with extreme ultraviolet radiation as the only source of energy input. Two models of vertical flow are assummed and horizontal flow is neglected. The results yield a maximum at 1800 local time. Other dynamical effects are discussed. Author

N71-25090*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESIGN AND PRELIMINARY TESTING OF A BRAYTON SPACE RADIATOR CONCEPT

T. J. Miller, J. P. Couch, and G. M. Pok [1971] 10 p refs Proposed for Presentation at 1971 Intersoc. Energy Conversion Eng. Conf., Boston, 3–6 Aug. 1971; sponsored by SAE (NASA-TM-X-67822) Avail: NTIS CSCL 20M

A low temperature radiator has been designed to reject 17.62 kW of thermal power from an isotope Brayton power system. This power system has an electrical output of 7.1 kW. The total radiator consists of two radiators connected in series. Both radiators have a redundant coolant loop, shared fins, and are close to flight configuration. A silicone oil (2 cs viscosity at 537 R) is used as the working fluid. Low flow rates and moderate pressure drop in the radiator required a small hydraulic diameter with large heat transfer area and large flow area. To obtain these characteristics and meet schedule limitations, an expanded tube configuration (with an approximate trapezoidal cross section) was selected. The results of these tests were in good agreement with predictions. Author

N71-25313*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A SPACE APPLICATION OF A CRYOGENIC HEAT PIPE

Robert A. Callens *In its* Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center 1970 p 244–248 (See N71-25256 13-34)
Avail: NTIS HC$6.00/MF$0.95 CSCL 20M

A generalized mathematical cryogenic heat pipe model is formulated and tested against experimental results for potential space application. Comparison with data from a one foot long device that used a rayon wick and LN2 as the cryogen shows good agreement in the area of less than 20 W for integrated cryogenic cooling engines. G.G.

N71-25351* Goodyear Aerospace Corp., Akron, Ohio

PANELIZED HIGH PERFORMANCE MULTILAYER INSULATION Patent

James M. Stuckey, Ralph A. Burkley, and Clem B. Shriver, inventors (to NASA) Issued 17 Nov. 1970 (Filed 30 Jan. 1969) 8 p Cl. 220-9; Cl. 52-249; Cl. 52-404; Cl. 62-45; Cl. 161-161; Int. Cl. B65d25/18 Sponsored by NASA
(NASA-Case-MFS-14023; US-Patent-3,540,615; US-Patent-Appl-SN-795217) Avail: US Patent Office CSCL 20M

An insulation structure for cryogenic containers is described that comprises a plurality of prefabricated panels conforming to the shape of the container. The panels are secured together in edge-to-edge relationship to form at least two panel layers covering the container, with the panel edges in the respective layers being overlapped. Each of the panels is made up of multiple layers of metallized film radiation shields interleaved with layers of low conductivity foam sheet. The outer panel layer is covered with resin impregnated fiberglass cloth to provide micrometeoroid protection. Official Gazette of the U.S. Patent Office

N71-25353* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

ISOTHERMAL COVER WITH THERMAL RESERVOIRS Patent

Ambrose W. Byrd, inventor (to NASA) Issued 22 Dec. 1970 (Filed 30 Jul. 1969) 5 p Cl. 165-105; Cl. 165-104; Cl. 165-133; Cl. 244-1; Cl. 219-378; Cl. 219-530; Int. Cl. F28d15/00
(NASA-Case-MFS-20355; US-Patent-3,548,930; US-Patent-Appl-SN-845974) Avail: US Patent Office CSCL 20M

An isothermal cover for a spacecraft is reported. The device is a double walled cylinder enclosing a number of containers of fusible material, mounted on struts inside the walls of the cylinder, for use as heat reservoirs. The inside surfaces of the cylinder and the outside surfaces of the containers and struts are covered with a wicking material. The cavity of the double walled cylinder also contains a heat transfer fluid. The device functions as a heat pipe in transferring heat from its sunlit to its other (dark) side. The heat reservoirs store heat when the device is in sunlight and return the heat to the system when the device is in darkness. Official Gazette of the U.S. Patent Office

N71-25354*# Michigan State Univ., East Lansing. Dept. of Physics.

COUPLING BETWEEN PRESSURE AND TEMPERATURE WAVES IN LIQUID HELIUM

Garold F. Fritz (Ph.D. Thesis) 1970 90 p refs Sponsored in part by NASA and AEC
(NASA-CR-118352; COO-1574-19) Avail: NTIS CSCL 20M

When the thermal expansion coefficient alpha is retained in the linearized hydrodynamic equations of the two-fluid model of superfluid liquid helium, pressure and temperature waves are not independent. Thus, a periodically varying temperature source produces not only temperature waves in liquid helium, but also two pressure waves which propagate at the velocity of first and second sound, respectively. Similarly, a vibrating diaphragm produces not only pressure waves but also two temperature waves which also propagate at the velocity of first and second sound, respectively. This coupling is investigated by observing and studying the two pressure waves produced by a heater and the temperature wave produced by a capacitor microphone. Author (NSA)

N71-25355# Los Alamos Scientific Lab., N.Mex.
ENTHALPIES OF SOLUTION OF SELECTED ELEMENTS IN SEVERAL LIQUID METAL SOLUTIONS
David F. Bowersox Dec. 1970 9 p refs
(Contract W-7405-eng-36)
(LA-4559) Avail: NTIS

The calculation of partial molar enthalpies and entropies of elements that form simple eutectic-type binary systems with plutonium are reviewed. The partial molar enthalpies of solution of several elements that form compounds or solid solutions with plutonium have been calculated by regular solution theory from solubility data. The calculated enthalpies are (in kcal/mole): carbon, 10.5; thulium, 9.2; manganese, 4.8; rhenium, 10.5; zirconium, 4.2; titanium, 4.1 from 700 to 750 C, and 5.3 from 800 to 1000 C. The regular solution theory has also been applied to other systems to calculate enthalpies from published solubility data. These results are compared with an empirical approach. Author (NSA)

N71-25356# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
HEAT TRANSFER COEFFICIENT AS A FUNCTION OF STEAM QUALITY FOR HIGH PRESSURE ONCE THROUGH FLOW BOILING, WITH DETERMINATION OF THE TRANSITION POINTS BETWEEN THE REGIONS OF PARTICULAR HEAT TRANSFER
L. Nobel Nov. 1970 70 p refs
(EUR-4561-e) Avail: AEC Depository Libraries

In once-through steam generators, the water enters the generator at a temperature far below the saturation temperature and leaves it as superheated steam; heat transfer taking place according to different mechanisms, each of which is active over a limited length of the tubes. As far as the present state of knowledge permits, the heat transfer coefficient for a particular heat transfer region is determined analytically as a function of the mathematical steam quality for different heat and mass fluxes and pressures between 170 and 210 bar. The assumption that the pipe length over which film boiling takes place can be determined by using an analogy with a water-jet-gas-pump aggregate seems to give a useful correlation equation. Author (NSA)

N71-25357# Westinghouse Electric Corp., Pittsburgh, Pa.
EFFECT OF 75 PERCENT TO 100 PERCENT FLOW BLOCKAGE ON BOTTOM COOLING HEAT TRANSFER EFFECTIVENESS
D. P. Dominicis, F. F. Cadek, R. H. Leyse, and J. O. Cermak [1970] 5 p refs Sponsored by AEC
(WCAP-5353) Avail: NTIS

Two series of flow blockage tests were performed to determine the effect of flow blockage on heat transfer in bottom flooding. The tests in which blockage was varied from a uniform 75% blockage of the flow area of a 10 x 10 rod bundle to 100% blockage of 16 flow channels with the rest of the bundle blocked 75% to 90% are described. The heat generation in the rods was distributed in an axial cosine shape of 1.66 peak to average with simulation of decay heating. The rods were stainless steel clad with internal heating elements. Results of the tests are presented. Author (NSA)

N71-25358# Advisory Group for Aerospace Research and Development, Paris (France).
THERMOPHYSICAL PROPERTIES OF SOLID MATERIALS: COOPERATIVE THERMAL EXPANSION MEASUREMENTS UP TO 1000 C. PROJECT SECTION 1A
E. Fitzer Mar. 1971 65 p refs
(AGARD-AR-31-71) Avail: NTIS

Pushrod dilatometer measurements to 1000 C as carried out by employing samples having the same history were evaluated both statistically and with regard to the nature of the errors involved. Using high purity gold and platinum as selected reference materials, it was found that the relative pushrod dilatometer measurements when used in a group effort can yield an accuracy equal to that obtained by individual absolute measurements. This result was confirmed with engineering materials such as an austenitic alloy, a Ta/10 W alloy, sintered alumina and fine grain graphites. Author

N71-25359# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE WORK OF TURBINE AND INJECTION BURNERS ON A GAS VARIABLE COMPOSITION
B. P. Adinskov et al 1 Dec. 1970 15 p refs Transl. into ENGLISH from Gaz. Prom. (Moscow), v. 14, no. 11, 1969 p 35-39
(AD-719834; FTD-MT-24-273-70) Avail: NTIS CSCL 21/5

Combustion and aerodynamic installations are described which are used to determine amount of air (gas to air ratios) required to burn fuels of different compounds in turbojet or injection burners. Equations were developed to calculate the air requirements in turbojet and injection systems when changing feed gases of known density and compositions. Author (GRA)

N71-25484# Oregon State Univ., Corvallis. Dept. of Mechanical and Nuclear Engineering.
NATURAL CONVECTION HEAT TRANSFER IN LIQUID METALS Progress Report, 1 Apr. 1969 - 31 Dec. 1970
James R. Welty 1970 139 p refs
(Contract AT(45-1)-2094)
(RLO-2227-T-4-1) Avail: NTIS

Activities in an investigation conducted to gain better understanding of natural convection heat transfer are reported. The test geometry used was a flat plate immersed in a pool of mercury. It was found that the velocity and temperature profiles have an x dependency as well as a modified Grashof and Grashof number dependency. This was predicted by perturbation but not by similarity or integral analysis. Results of analyses of heat transfer equations and temperature profiles suggest that the heat transfer may be higher than previously expected. The pseudo-constant temperature plate is, at the very best, a first approximation and the results obtained must be used with care (particularly, the heat transfer equation). Author (NSA)

N71-25486*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFICIENCIES OF HONEYCOMB ABSORBERS OF SOLAR RADIATION
E. M. Sparrow, William J. Bifano, and Jeanne A. Healy Washington May 1971 45 p refs
(NASA-TN-D-6337; E-6074) Avail: NTIS CSCL 20M

An analysis was made to determine the efficiency of solar energy absorption of a system consisting of a honeycomb structure affixed to a collecting base surface. For the study, it was assumed that the incoming solar radiation is perfectly collimated and impinges directly on the base surface. A two-band model (solar and infrared) was used in formulating the governing equations which account for simultaneous radiation and conduction. Honeycomb absorption efficiencies are presented for a range of radiation surface properties and dimensionless parameters involving honeycomb geometry, wall thermal conductivity, temperature level, and solar energy flux. In addition, the honeycomb efficiencies are compared to those of plane plate absorbers. Author

N71-25487# Research Inst. of National Defence, Stockholm (Sweden).
THERMAL RADIATION FRONT FROM A POINT EXPLOSION
N. Hoernqvist Oct. 1969 22 p refs
(FOA-4-C-4402-23(25)) Avail: NTIS

The propagation of thermal radiation from a point explosion is considered, using the radiation diffusion approximation. The existence of a sharp forward boundary, a radiative front, is demonstrated by the exact solutions to the one-dimensional plane, cylindrical and spherical cases. Author

N71-25468*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUPERSONIC COMBUSTION OF HYDROGEN IN A VITIATED AIR STREAM USING STEPPED WALL INJECTION
M. C. Burrows and A. P. Kurkov [1971] 15 p refs Presented at 7th Propulsion Joint Specialist Conf., Salt Lake City, 14–18 Jun. 1971; sponsored by AIAA
(NASA-TM-X-67840) Avail: NTIS CSCL 21B

Detailed probe measurements of temperature, pressure, and composition were taken within a two dimensional test section. A high pressure gas generator supplied Mach 2.5 vitiated air or inert gas at elevated temperatures. Special water-cooled probes and sampling techniques were developed for the short test times required by heat-sink hardware. Independent methods of measuring stream total temperature are compared. The mixing boundary of hydrogen with the supersonic gas stream was substantially wider in the presence of combustion. Ignition of hydrogen, as determined from photographic exposures of the radiating gases, varied from 31 cm downstream from injection to 11 cm for a 20 K variation in stream static temperature. Ignition times correspond to literature values for lean mixtures. Author

N71-25469# Illinois Univ., Urbana.
TEMPERATURE CHANGES IN THIN FILMS DURING GROWTH BY PHYSICAL VAPOR DEPOSITION
D. D. Thornburg and C. M. Wayman 1970 24 p refs
(Contract AT(11-1)-1198)
(COO-1198-778) Avail: NTIS

A theory has been developed to determine the temperature of a thin film during its growth by physical vapor deposition in vacuo from a resistance heated source. Three sources of heat which contribute to the film temperature are: (1) radiation losses from the source, (2) kinetic equilibration of the condensing vapor stream, and condensation of the evaporant. By assuming planar substrate geometry, the heat equation was solved for the case in which the bottom of the substrate was held at constant temperature and the top surface was subjected to the heat flux described above. Solutions of the heat equation were obtained with the aid of an analog computer constructed during the course of the investigation. By proposing a model for substrate surface coverage as a function of time during growth, it is shown that when a metal film is deposited on substrates of high emissivity, a plot of film temperature vs time displays a maximum which can be related to deposition rate. Author

N71-25492# Oak Ridge National Lab., Tenn.
HEATING 3: AN IBM 360 HEAT CONDUCTION PROGRAM
W. D. Turner and M. Siman-Tov Feb. 1971 93 p refs Sponsored by AEC
(ORNL-TM-3208) Avail: NTIS

A modified version of the HEATING program (Heating 3) is designed to solve steady state and/or transient heat conduction problems in one, two, or three dimensional Cartesian or cylindrical coordinates. Thermal conductivity, density, and specific heat may be dependent on temperature. Heat generation rates may be dependent on position and time, and the boundary temperatures may be time dependent. The boundary conditions may be fixed temperatures or any combination of constant heat flux, forced convection, natural convection, and radiation. The extrapolated Liebmann method and a modification of the Aitken delta squared extrapolation process are used to solve the finite difference equations which approximate the partial differential equations for a steady state problem. The difference equations for a transient problem involve the first forward time difference, and thus, the solution is expressed explicitly in terms of the temperatures at the previous time level. For transient calculations, a modified explicit method is incorporated into the program as an option which allows the use of an arbitrary time increment while maintaining stability. Author

34 GENERAL

Includes information of a broad nature related in industrial applications and technology, and to basic research; defense aspects; information retrieval; management; law and related legal matters; and legislative hearings and documents.

N71-24444# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
FLASH RADIOGRAPHY IN BALLISTIC TESTING Final Report
25 Nov. 1970 13 p refs
(AD-719088; MTP-4-2-825) Avail: NTIS CSCL 19/4

The Engineering Test Procedure provides guidance in the use of high-speed flash radiographic instrumentation in gathering ballistic test data. Procedures are defined for obtaining shadowgraphs and radiographs showing aspects of projectile performance. Author (GRA)

N71-24445# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
SOLID STATE, PLASMAS AND APPLIED ELECTROMAGNETICS, INFORMATION SCIENCES AND BIOMEDICAL ENGINEERING AND MATHEMATICS Consolidated Semiannual Annual Progress Report, 1 Apr.–30 Sep. 1970
30 Sep. 1970 254 p refs
(Grant AF-AFOSR-1622-69)
(AD-718982; SAPR-12) Avail: NTIS CSCL 20/12

Contents: Semiconductors; Quantum electronics and lasers; Magnetism; Defects in crystals; Metals; Plasmas; Millimeter wave radiometry; Control systems; Communication and radar systems; Switching, automata theory, and computers; Biomedical engineering; and Biomedical mathematics. GRA

N71-24447# European Space Research Organization, Paris (France).
EUROPEAN SPACE RESEARCH ORGANISATION General Report, 1969
1970 204 p
Avail: NTIS

This report summarizes the scientific results achieved by the ESRO satellites (IRIS, AURORAE, HEOS 1) and from the sounding rocket campaign. A status report is given of satellites under development, namely BOREAS, TD-1, HEOS-A2, and ESRO-4 and the feasibility studies presented on future satellites in the telecommunications, meteorological and aeronautical fields. A summary is also given of the management problems involving buildings, staff, and legal matters. ESRO

N71-24463# Aeroplane and Armament Experimental Establishment, Boscombe Down (England). Performance Div.
A DISCUSSION ON UNITS, UNIT SYMBOLS AND ABBREVIATIONS FOR USE AT A AND AEE
Kathleen Richardson 9 Sep. 1970 29 p refs
(AAEE-TECH-425) Avail: NTIS

The association of A and AEE work with operational considerations will necessitate the parallel use of traditional and metric units for some years to come and not all metric engineering information will be in pure SI units. To provide guidance on correct

use, the relationships between SI units, non-SI units likely to be used commonly in engineering applications and current international operational units are reviewed. The presentation of numerical values is discussed. Rules to promote uniformity in the formulation of abbreviations at A and AEE are given. Author (ESRO)

N71-24464# Royal Swedish Academy of Engineering Sciences, Stockholm.
DE LAVAL MEMORIAL LECTURE/1970
1970 36 p refs *Its* IVA Medd. 165
Avail: NTIS

CONTENTS:

1. IT BEGAN WITH A FARM SEPARATOR S. Strandh p 3-15 refs (See N71-24465 13-34)

2. DEVELOPMENT OF SEPARATION METHODS APPLIED TO BIOCHEMICAL MATERIALS A. Tiselius p 17-33 refs (See N71-24466 13-04)

N71-24465# Royal Swedish Academy of Engineering Sciences, Stockholm.
IT BEGAN WITH A FARM SEPARATOR
Sigvard Strandh *In its* De Laval Mem. Lecture/1970 p 3-15 refs (See N71-24464 13-34)
Avail: NTIS

The development of separators using centrifugal force is discussed. The difficulties and problems encountered and the methods of overcoming them are described as well as the uses for which the separators were designed. ESRO

N71-24751# Committee on Science and Astronautics (U. S. House).
INTERNATIONAL SCIENCE POLICY Conference Papers
Washington GPO Feb. 1971 166 p refs A compilation of papers prepared for the 12th Meeting of the Panel on Sci. and Technol., 1971, presented by Comm. on Sci. and Technol. to the US Congr., Feb. 1971 Supplement to the Proc. of the Panel
Avail: SOD $0.75

CONTENTS:

1. INTERNATIONAL COOPERATION IN THE ENVIRONMENTAL SCIENCES W. O. Roberts (Univ. Corp. for Atmospheric Res.) p 11-33 (See N71-24752 13-34)

2. INTERNATIONAL COOPERATION IN THE PHYSICAL SCIENCES A. Salam (Intern. Centre for Theoret. Phys.) p 35-49 (See N71-24753 13-34)

3. NEW MECHANISMS FOR SCIENTIFIC COOPERATION IN THE FUTURE V. A. Ambartsumian (Intern. Council of Sci. Unions, Rome, Italy) (Acad. of Sci. of the Armenian SSR) p 51-60 (See N71-24754 13-34)

4. SCIENCE, TECHNOLOGY, THE MILITARY AND ARMS CONTROL F. A. Long (Cornell Univ., Ithaca, N.Y.) p 61-72 (See N71-24755 13-34)

5. NATIONAL SCIENCE POLICY: PRELUDE TO GLOBAL COOPERATION E. Q. Daddario (Gulf and Western Precision Eng. Co., Manchester, Conn.) p 73-80 (See N71-24756 13-34)

6. ADMINISTRATIVE REQUIREMENTS FOR ADVANCING INTERNATIONAL SCIENCE POLICY J. E. Webb (Natl. Acad. of Public Admin., Washington, D.C.) p 81-90 (See N71-24757 13-34)

7. INTERNATIONAL COOPERATION IN THE SOCIAL AND LIFE SCIENCES T. R. Odhiambo (Nairobi Univ., Kenya) p 91-109 (See N71-24758 13-34)

8. THE LEGISLATIVE ROLE IN SCIENCE POLICY A. Grosart (Steering Committee on Sci. Policy), p 111-121 refs (See N71-24759 13-34)

9. SCIENCE, TECHNOLOGY AND THE DEVELOPING COUNTRIES H. S. Brown (Natl. Acad. of Sci. Natl. Res. Council, Wash., D.C.) p 123-132 (See N71-24760 13-34)

10. THE ROLE OF SCIENCE POLICY IN SOLVING SOCIAL PROBLEMS. THE UNBALANCED PROGRESS OF PROGRESS S. B. Linder (Handelshoegskolen i. Stockholm, Sweden) p 133-141 (See N71-24761 13-34)

11. INTERNATIONAL SCIENCE POLICY IN THE MARINE ENVIRONMENT J. Y. Cousteau (Centre d'Etudes Marines Avancees, Marseilles, France) p 143-148 (See N71-24762 13-34)

12. POTENTIAL CONSEQUENCES OF EXPERIMENTATION WITH HUMAN EGGS J. D. Watson (Harvard Univ., Cambridge, Mass.) p 149-161 refs (See N71-24763 13-04)

N71-24752# University Corp. for Atmospheric Research, Boulder, Colo.
INTERNATIONAL COOPERATION IN THE ENVIRONMENTAL SCIENCES
Walter Orr Roberts *In* Comm. on Sci. and Astronaut. (U. S. House) Intern. Sci. Policy Feb. 1971 p 11-33 (See N71-24751 13-34)
Avail: SOD $0.75

Environmental pollution problems of national and world aspects are outlined and international cooperative engineering requirements for global atmospheric research and other scientific and technological problems caused by man's intervention in the ecological balance of the biosphere are discussed. Emphasis is placed on: (1) increase in atmospheric carbon dioxide and dust contents and the resulting reduction in ultraviolet light; (2) land irrigation and cultivating effects on the microclimate; (3) greater rainfall volumes over cities caused by urban developments that include wind effects of high buildings and release of man-made freezing and condensation-nuclei into the atmosphere; and (4) possible climatic effects of SST deployments on a vast scale. The growing domains of weather modification and international environmental laws indicate increased cooperative efforts. G.G.

N71-24753# International Centre for Theoretical Physics, Trieste (Italy).
INTERNATIONAL COOPERATION IN THE PHYSICAL SCIENCES
Abdus Salam *In* Comm. on Sci. and Astronaut. (U. S. House) Intern. Sci. Policy Feb. 1971 p 35-49 (See N71-24751 13-34)
Avail: SOD $0.75

The creation of an International Science Foundation for coordinating physical research efforts by pooling costs, personnel, equipment, and technology is advocated. Group planning and the necessary international cooperation funds are imperative for implementing worldwide collaboration in physical sciences to perform the next great syntheses of fundamental sciences: gravity, nuclear physics, and electromagnetism as represented in the F-meson, a particle with identical quantum numbers as the graviton that transmits a nuclear force identical with gravity, except that it is much stronger. G.G.

N71-24754# International Council of Scientific Unions, Rome (Italy).
NEW MECHANISMS FOR SCIENTIFIC COOPERATION IN THE FUTURE
Viktor A. Ambartsumian (Acad. of Sci. of the Armenian SSR) *In* Comm. on Sci. and Astronaut (U. S. House) Intern. Sci. Policy Feb. 1971 p 51-60 (See N71-24751 13-34)
Avail: SOD $0.75

The problems of international scientific cooperation are a progressive factor in the life of humanity and should not be subjected to political tensions, and racial or national discriminations. Good relations between scientists taking part in various programs with frequent discussion meetings help to bring understanding among nations and the peoples of the world. The creation of a world system of scientific information is strongly recommended and examples of its application are projected. G.G.

N71-24755# Cornell Univ., Ithaca, N.Y. Program on Science, Technology and Society.
SCIENCE, TECHNOLOGY, THE MILITARY AND ARMS CONTROL
Franklin A. Long *In* Comm. on Sci. and Astronaut. (U. S. House) Intern. Sci. Policy Feb. 1971 p 61–72 (See N71-24751 13-34)
Avail: SOD $0.75

Increased sophistication, quantity, and effectiveness of military technology requires new scientific efforts to effectively control this burgeoning industry. Evaluation of the political and social impacts of modern military systems, considered by the concept of relative risks, leads to an exploration of alternatives to military systems and war, with special emphasis on arms control and disarmament along with peace keeping programs for the maintainance of stability. International scientists and engineers are urged to play an explanatory and tutorial role in their own countries so that the nations concerned have a clear understanding of the problems and opportunities involved. The development of a Joint Congressional Committee for National Security is proposed that studies nonmilitary alternatives as well as international needs and goals. G.G.

N71-24756# Gulf and Western Precision Engineering Co., Manchester, Conn.
NATIONAL SCIENCE POLICY: PRELUDE TO GLOBAL COOPERATION
Emilio Q. Daddario *In* Comm. on Sci. and Astronaut. (U. S. House) Intern. Sci. Policy Feb. 1971 p 73–80 (See N71-24751 13-34)
Avail: SOD $0.75

The question of how national science and technology can be best employed for the benefit of all mankind is considered and new approaches for broader international scientific and political cooperation are outlined. Aid to developing countries brings security and prevents resource exploitation; administration of international standards in global problems promotes health and well being. The development of an international science policy framework that breaks down traditional disciplinary barriers and uses new mechanisms for the transfer of research results into global applications is imperative. Global scientific cooperation promises to reduce the increasing alienation of mankind and provides means for holding things together since lack of confidence kills a civilization. G.G.

N71-24757# National Academy of Public Administration, Washington, D.C.
ADMINISTRATIVE REQUIREMENTS FOR ADVANCING INTERNATIONAL SCIENCE POLICY
James E. Webb *In* Comm. on Sci. and Astronaut. (U. S. House) Intern. Sci. Policy Feb. 1971 p 81–90 (See N71-24751 13-14)
Avail: SOD $0.75

A science policy effective as a part of an international aspiration must offer benefits for those nations which adopt and follow it. A system of international relations in the scientific sphere requires organization and administration for implementing cooperation. G.G.

N71-24758# Nairobi Univ. (Kenya). Faculty of Agriculture.
INTERNATIONAL COOPERATION IN THE SOCIAL AND LIFE SCIENCES
Thomas R. Odhiambo *In* Comm. on Sci. and Astronaut. (U. S. House) Intern. Sci. Policy Feb. 1971 p 91–109 (See N71-24751 13-34)
Avail: SOD $0.75

International social and life science efforts are required to close the gap between technologically advanced nations and the developing countries. Mechanisms for international science cooperation constitute printed matter, scientific meetings and conferences, post-doctoral fellowships, and patenting and selling of knowhow. Broad objectives and their implications for maximizing international scientific cooperation in research centers are discussed and general outlines of the organization and basic research projects of the International Center of Insect Physiology and Ecology located in Nairobi, Kenya, are given. G.G.

N71-24759# Steering Committee on Science Policy (Canadian Senate), Ottawa.
THE LEGISLATIVE ROLE IN SCIENCE POLICY
Allister Grosart *In* Comm. on Sci. and Astronaut. (U. S. House) Intern. Sci. Policy Feb. 1971 p 111–121 refs (See N71-24751 13-34)
Avail: SOD $0.75

The science policies of various countries are briefly described and the responsibilities of elected representatives in both funding and performance of research and development work are discussed. The application of social, economic, and technological criteria to overall national and international scientific productivity requires the involvement of qualified parliamentarians who can assess the value of a scientific program knowingly. G.G.

N71-24760# National Academy of Sciences—National Research Council, Washington, D.C.
SCIENCE, TECHNOLOGY AND THE DEVELOPING COUNTRIES
Harrison S. Brown *In* Comm. on Sci. and Astronaut. (U. S. House) Intern. Sci. Policy Feb. 1971 p 123–132 (See N71-24751 13-34)
Avail: SOD $0.75

Rapid economic development of the poor countries is essential and can be accelerated by expanded transfer of capital from the rich countries. A major increase in capital flow can only be effectively absorbed into a developing economy if there are enough trained human resources, and an adequate organizational structure in existence that permits decisions to be transformed effectively into actions. The channeling of capital assistance through international agencies is advocated and the creation of an International Development Institute is proposed. G.G.

N71-24761# Handelshoegskolan i Stockholm (Sweden).
THE ROLE OF SCIENCE POLICY IN SOLVING SOCIAL PROBLEMS. THE UNBALANCED PROGRESS OF PROGRESS
Staffan Burenstam Linder *In* Comm. on Sci. and Astronaut. (U.S. House) Intern. Sci. Policy Feb. 1971 p 133–141 (See N71-24751 13-34)
Avail: SOD $0.75

Adoption of a cautious, but well financed program of technological development is advocated in order to minimize the unbalancing effects between the progress of science and man by providing: (1) some moral advancement; (2) increased capacity to adjust to the demands of the new technology; (3) reallocation of time to stimulate pleasure activities with bigger injections of consumption goods; (4) solutions to environmental problems that cause serious social erosions; and (5) even spread of the benefits of modern science and technology. A definite science policy is required to solve the problems that the application of science has caused. G.G.

N71-24762# Centre d'Etudes Marines Avancees, Marseilles (France).
INTERNATIONAL SCIENCE POLICY IN THE MARINE ENVIRONMENT
Jacques Yves Cousteau *In* Comm. on Sci. and Astronaut. (U. S. House) Intern. Sci. Policy Feb. 1971 p 143–148 (See N71-24751 13-34)
Avail: SOD $0.75

The decrease of population and vitality of the ocean by more than 40% during the last 20 years is linked to evidence that all atmospheric-, land-, or sea pollution ends up in the oceans. Pollution elimination requires isolation of all toxic products from effluents in the water cycle, reduction of industrial development; and

control of the populations. National and international actions by the main polluters, the industrial nations, are projected to formulate and enforce global antipollution regulations. G.G.

N71-24901*# Battelle Memorial Inst., Columbus, Ohio.
A SURVEY OF AEROSPACE EMPLOYEES AFFECTED BY REDUCTIONS IN NASA CONTRACTS Final Report
20 May 1971 119 p refs
(Contract NASw-2176)
(NASA-CR-118374) Avail: NTIS CSCL 05K

The results of a survey of aerospace employees affected by reductions in NASA contracts are presented. The study was primarily directed toward data gathering rather than analysis. Time considerations dictated an early summarization of the basic survey results in sufficient detail to make the data available to various potential users. As a consequence, the report is heavily detailed in the presentation of the statistics gathered through the survey. Author

N71-24846# Ballistic Research Labs., Aberdeen Proving Ground, Md.
THE INFLUENCE OF HELICAL SERRATIONS AND BULLET ENGRAVING ON THE AERODYNAMIC AND STABILITY PROPERTIES OF A BODY ON REVOLUTION WITH SPIN
Maurice A. Sylvester and Walter F. Braun Nov. 1970 52 p refs
(AD-719235; BRL-1514) Avail: NTIS CSCL 19/1

Discrepancies in the predicted and observed stability behavior of bullets sometimes occur at longer ranges. Experiments in the BRL supersonic wind tunnel and range suggest that this behavior may be due to subtle aerodynamic effects of the helical engraving. The wind tunnel tests were made at supersonic Mach numbers on spinning models with accentuated helical serrations. The tests covered a range of angle of attack, Reynolds number and mismatch between the spin of the model and the twist of the serrations. The range data were obtained on both standard ammunition and models. Author (GRA)

N71-24847# Stanford Univ., Calif. Electronics Labs.
ELECTRONIC EQUIPMENT DEVELOPMENT, TECHNIQUES, AND APPLICATIONS Semiannual Status Report, 1 Jul.–31 Dec. 1970
31 Dec. 1970 134 p refs
(Contract N00014-67-A-0112-0044)
(AD-719400; SU-SEL-70-076; SASR-119) Avail: NTIS CSCL 20/5

Contents: Plasma physics; Quantum electronics; Radioscience; Solid-state electronics; Systems theory; Digital systems; and Information systems. GRA

N71-24925# National Transportation Safety Board, Washington, D.C.
REPORT OF THE NATIONAL TRANSPORTATION SAFETY BOARD Annual Report to Congress, 1970
17 Mar. 1971 61 p refs
(AR-4) Avail: Issuing Activity

The activities of the Transportation Safety Board for 1970 are reported. Among the transportation safety's list of 10 worst enemies are: alcohol, ineffective 'packaging' of motorists and pilots, youth and highway fatalities, and induced pilot error. Safety in aviation and surface transportation is discussed. A summary of investigations and recommendations is included. F.O.S.

N71-25024*# Techtran Corp., Glen Burnie, Md.
AVIATION AND ASTRONAUTICS IN THE USSR
A. A. Izmaylov, ed. Washington NASA May 1971 652 p refs Transl. into ENGLISH of the book 'Aviatsiya i Kosmonavtika SSSR Moscow, Mil. Press, 1968 p 1–599
(Contract NASw-1695)
(NASA-TT-F-13142) Avail: NTIS HC $9.00/MF $0.95 CSCL 05D

The history of the development of aviation in the U.S.S.R. is reviewed. Starting with aviation in prerevolutionary Russia, the stages during the periods of the civil war, building socialism, World War 2, and postwar period are discussed with the birth and development of astronautics. Lists of aviation heroes of the Soviet Union are also included. F.O.S.

N71-25187*# Stanford Research Inst., Menlo Park, Calif.
ACTIVITIES OF THE NASA SPONSORED SRI TECHNOLOGY APPLICATIONS TEAM IN TRANSFERRING AEROSPACE TECHNOLOGY TO THE PUBLIC SECTOR Semiannual Report, 1 Jul.–31 Dec. 1970
Joseph G. Berke Jan. 1971 39 p
(Contract NASw-1992; SRI Proj. PAU-8368)
(NASA-CR-118273) Avail: NTIS CSCL 05B

The activities in the technology transfer program are reported. Seven potential applications of technology are discussed with the impact on the general public. These include: measuring reflectance spectrum of small samples, morphine analysis in urine, method of analysis for metals and metal products, nondestructive measurement of the thickness of concrete pavements, portable device for recording eye motion, and sewage processor for highway rest stops. A list is included of currently active problems. F.O.S.

N71-25190# RAND Corp., Santa Monica, Calif.
PUBLICATIONS OF THE SOCIAL SCIENCE DEPARTMENT, 1963–1970
Doris Corbin, comp. Mar. 1971 78 p refs
(R-705) Avail: NTIS

Publications written by members of the Social Science Department of The Rand Corporation from January 1963 through December 1970 are listed and briefly described. Books that have resulted from social science studies since the department's inception are also listed. Author

N71-25194# Committee on Science and Astronautics (U.S. House).
NASA AUTHORIZATION, 1972, PART 2
Washington GPO 1971 1207 p refs Hearings on H.R. 3981 (Superseded by H.R. 7109) before Comm. on Sci. and Astronaut., 92d Congr., 1st Sess., No. 2, 4 Mar. 1971; also in Huntington Beach, Calif., 2 Apr. 1971; Downey, Calif., 2 Apr. 1971; Redondo Beach, Calif., 3 Apr. 1971; Sacramento, Calif., 3 Apr. 1971; and Sunnyvale, Calif., 5 Apr. 1971
Avail: Subcomm. on Manned Space Flight

The status of the NASA space flight program is documented in the form of prepared statements, field hearing testimony, information submitted for the record, and replies to questions for the record. Field hearings were held at the facilities of major aerospace contractors; information for the record was submitted by other major aerospace contractors as well as the Marshall Space Flight Center, the Manned Spacecraft Center at Houston, and the Kennedy Space Center. E.C.

N71-25195# Committee on Science and Astronautics (U.S. House).
NASA AUTHORIZATION, 1972, PART 3
Washington GPO 1971 312 p refs Hearings on H.R. 3981 (Supersedes by H.R. 7109) before Comm. on Sci. and Astronaut., 92d Congr., 1st Sess., No. 2, 18–19 and 22 Mar. 1971
Avail: Subcomm. on Space Sci. and Appl.

Activities and goals of the Office of Space Science and Applications are reviewed. The Office has three main responsibilities: (1) to apply space flight techniques to achieve an increased understanding of the universe and the laws that govern its behavior,

(2) to use space technology in the solution of practical problems on earth, and (3) to provide technical consultation to other elements of the Federal Government and industry on space matters. E.C.

N71-25196# Committee on Science and Astronautics (U.S. House).

NASA AUTHORIZATION, 1972, PART 4

Washington GPO 1971 325 p refs Hearings on H.R. 3981 (Superseded by H.R. 7109) before Comm. on Sci. and Astronaut., 92d Congr., 1st Sess., No. 2, 18 and 23 Mar. 1971

Avail: Subcomm. on Advan. Res. and Technol.

Statements and testimony are presented on NASA research and program management facilities, tracking and data acquisition, space research technology, and nuclear power and propulsion. Also documented are hearing materials on technology utilization and aeronautics research and technology. Sixteen prepared statements on these NASA programs are included. E.C.

N71-25219*# National Aeronautics and Space Administration, Washington, D.C.

LOOKING INTO THE FUTURE

B. Petrov May 1971 5 p Transl. into ENGLISH from Pravda (Moscow), 12 Apr. 1971 p 3

(NASA-TT-F-13674) Avail: NTIS CSCL 05B

An overview is presented of the scientific accomplishments that have taken place in the first decade of the space age and the direction in which space technology is headed in the next decade. Particular emphasis is placed on efforts by the U.S.S.R. in space research. D.L.G.

N71-25226# Joint Publications Research Service, Washington, D.C.

TOWARD A SCIENCE OF INFORMATION

E. P. Semenyuk 7 May 1971 23 p refs Transl. into ENGLISH from Nauchn.-Tekhn. Inform. (USSR), Ser. 1, no. 1, 1971 p 5-13

(JPRS-53067) Avail: NTIS

The formulation of a general science of information is discussed with reference to Shannon's information theory which is considered to investigate information quantity, and includes optimal methods of information coding and transmission channels (communications theory). The interpretation of cybernetics as the broad science of information is also discussed. The formulation is considered for each of the general attributes of a scientific discipline which are: definition of the object of investigation, development of concepts corresponding to this object, establishment of the fundamental law inherent of the given object, and discovery of the principle or creation of the theory permitting explanation of a set of facts. The term informology is suggested for this discipline. F.O.S.

N71-25238# Committee on Aeronautical and Space Sciences (U. S. Senate).

SPACE COOPERATION BETWEEN THE UNITED STATES AND THE SOVIET UNION

Washington GPO 1971 33 p Hearing before Comm. on Aeronaut. and Space Sci., 92d Congr., 1st Sess., 17 Mar. 1971

Avail: Comm. on Aeronaut. and Space Sci.

A report to the committee by Dr. George Low, Acting Administrator of NASA, is presented. The rendezvous and docking agreement and the January 1971 agreement to exchange scientific data and lunar samples are discussed. Astronaut rescue, the expected Mars landing by a Soviet probe, planetary information exchange, Soviet press criticism of Apollo 14, and comparisons of the Soviet and United States space R and D policies and costs are also considered. Benefits which might accrue from continued cooperation are indicated. N.E.N.

N71-25249*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

PUBLICATIONS OF THE JET PROPULSION LABORATORY: JULY THROUGH DECEMBER 1970

15 May 1971 146 p refs

(Contract NAS7-100)

(NASA-CR-118265; JPL-Bibl-39-12) Avail: NTIS CSCL 05B

The bibliography describes and indexes the formalized technical reporting that resulted from scientific and engineering work performed, or managed, by the Jet Propulsion Laboratory. Four classes of publications are included: (1) technical reports, in which the information is complete for a specific accomplishment and is intended for a wide audience; (2) technical memorandums, in which the information is complete for a specific accomplishment but is intended for a limited audience to satisfy unique requirements; (3) Articles from three volumes of the Space Programs Summary; and (4) open literature articles that were not selected for reprint as technical reports. The publications are indexed by author, publication type and number, and subject. A descriptive entry appears under the name of each author of each publication; an abstract is included with the entry. Author

N71-25256*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SIGNIFICANT ACCOMPLISHMENTS IN SCIENCE AND TECHNOLOGY AT GODDARD SPACE FLIGHT CENTER, 1969

Washington 1970 376 p Proc. of a Symp. held at Greenbelt, Md., 3-4 Dec. 1969 Original contains color illustrations

(NASA-SP-251) Avail: NTIS HC $6.00/MF $0.95 CSCL 04A

Accomplishments in space science and technology for the year 1969 are reviewed. Topics include satellite sensing and tracking systems, spaceborne observations of planetary atmospheres, and theoretical and experimental evaluations of spacecraft equipment. For individual titles, see N71-25257 through N71-25341.

N71-25472*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GODDARD RESEARCH AND ENGINEERING MANAGEMENT EXERCISE (GREMEX)

Richard F. Baker, ed. Washington May 1971 18 p

(NASA-TN-D-6347; G-1014) Avail: NTIS CSCL 05A

Goddard Research and Engineering Management Exercise (GREMEX) is a computer assisted management simulation exercise. Participants (individuals or teams) learn to become more effective managers by manipulating factors of time, cost, and technical performance in a research and development project environment. Participants must deal with human relations factors and random accidents of nature as well. GREMEX may be purchased at a nominal cost for non-NASA use. Little or no modification is required for many career development requirements. Author

N71-25529*# Office of Naval Research, Washington, D.C. Ocean Technology Branch.

PROJECT TEKTITE 1: A MULTIAGENCY 60 DAY SATURATED DIVE CONDUCTED BY THE UNITED STATES NAVY, THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, THE DEPARTMENT OF THE INTERIOR, AND THE GENERAL ELECTRIC COMPANY Summary Report

D. C. Pauli and H. A. Cole, eds. 16 Jan. 1970 60 p Sponsored in part by NASA, Dept. of Interior, and GE

(NASA-CR-118333; AD-702060; ONR-DR-153-S) Avail: NTIS CSCL 08J

An ocean floor habitat at a 49 foot depth and the supporting facilities were established and evaluated for 60 days at a carefully selected, isolated site in the Virgin Islands from February 15 to April 15, 1969. Four marine scientists lived in and worked out of the habitat for the 60-day period, during which their research emphasized marine biology and geology. This was twice as long as men had previously lived under saturated diving conditions and the only such experiment to use a controlled nitrogen/oxygen atmosphere with a normal 0.2-atmosphere oxygen partial pressure.

Through continual television and auditory monitoring, medical doctors, psychologists, and diving engineers studied the aquanauts biomedical responses to the 60-day saturation dive and their behavioral and other psychological responses to each other, to their work, and to their isolated, hostile environment. Author (GRA)

N71-25550# Royal Aircraft Establishment, Farnborough (England).
SWEDISH DEFENCE RESEARCH ABSTRACTS, ISSUE 69/70-4 [FROE FOERSVARS FORSKNINGS REFERAT OEPPEN DEL 69/70-4]
Feb. 1971 53 p Transl. into ENGLISH from Swedish reports
(RAE-LIB-TRANS-1542) Avail: NTIS

This volume covers the fourth quarter of 1970. The main topics covered are: (1) studies in systems analysis; (2) nuclear reactions; (3) chemical and biological warfare; (4) conventional warfare; (5) applied physics; (6) teletechniques; (7) biotechnology; (8) other investigations; (9) military psychology; and (10) psychological defense. Author

N71-25569# Defence Research Board, Ottawa (Ontario).
[LAND, SEA, AND AIR DEFENCE RESEARCH ACTIVITIES, 1970]
1970 102 p
(DR-206) Avail: NTIS CSCL 14B

Military scientific research and development programs at the Defence Research Board headquarters and its seven subordinate facilities are reviewed. The status of research programs at universities, industrial programs, and the Board's scientific information system is also examined. E C

N71-25572# Committee on Science and Astronautics (U. S. House).
TECHNICAL INFORMATION FOR CONGRESS From Subcommittee on Science, Research, and Development
Washington GPO 15 Apr. 1971 868 p refs Rept. presented to Comm. on Sci. and Astronaut., 92d Congr., 1st Sess., 15 Apr. 1971 Prepared by the Library of Congr. Sci. Policy Res. Div. Revised *Its* Serial A
Avail: SOD $3.50

The results of a study to improve the interaction of science and politics are presented. The general aim of the study is to develop an understanding of the process of drawing from the scientific community information and guidance needed by the Congress in legislating on issues with a substantial technical content. Lessons learned from previous legislation involving highly scientific subjects are presented to point out strengths and weaknesses of present relationships between the Congress and the scientific community. P.N.F.

N71-25595# Royal Aircraft Establishment, Farnborough (England).
CABTRACK STUDIES: ASSESSMENT OF AUTOTAXI URBAN TRANSPORT SYSTEMS, PART 1
Dec. 1968 219 p refs
(RAE-TR-68287-Pt-1) Copyright. Avail: NTIS

The first phase is described of an investigation into the technical and economic problems of Autotaxi systems as a new mode of urban transport. The study was based on a hypothetical fine mesh network covering Central London, but the results are of general application. Aspects studied include traffic demand, network analysis, system control, and costing. The results were sufficiently encouraging to merit further study of the system. Author

N71-25596# Iowa State Univ. of Science and Technology, Ames.
CERAMIC ENGINEERING, CHEMICAL ENGINEERING, CHEMISTRY, MATHEMATICS AND COMPUTER SCIENCE, METALLURGY, PHYSICS, AND REACTOR DIVISIONS Annual Summary Research Report, Jul. 1969 - Jun. 1970
Nov. 1970 273 p refs
(Contract W-7405-eng-82)
(IS-2300) Avail: NTIS

Programs of research and development reported include: (1) reactor materials development; (2) systems and materials chemistry; (3) materials preparation and characterization; (4) nuclear, structural, and inorganic chemistry; (5) chemistry of the heavy transition elements; (6) radiation, isotope, and physical chemistry; (7) computer research and development; (8) mathematics research; (9) engineering properties of reactor materials; (10) reactor fuels and cladding; (11) high energy physics; (12) low energy physics; and (13) fuel burnup, refueling operations, and general utilization of the Ames Laboratory research reactor. D.L.G.

PUBLIC COLLECTIONS OF NASA DOCUMENTS

DOMESTIC

NASA deposits its technical documents and bibliographic tools in eleven Federal Regional Technical Report Centers located in the organizations listed below. Each center is prepared to furnish the public such services as reference assistance, interlibrary loans, photocopy service, and assistance in obtaining copies of NASA documents for retention.

CALIFORNIA
University of California, Berkeley

COLORADO
University of Colorado, Boulder

DISTRICT OF COLUMBIA
Library of Congress

GEORGIA
Georgia Institute of Technology, Atlanta

ILLINOIS
The John Crerar Library, Chicago

MASSACHUSETTS
Massachusetts Institute of Technology, Cambridge

MISSOURI
Linda Hall Library, Kansas City

NEW YORK
Columbia University, New York

PENNSYLVANIA
Carnegie Library of Pittsburgh

TEXAS
Southern Methodist University, Dallas

WASHINGTON
University of Washington, Seattle

NASA publications (those indicated by an "*" following the accession number) are also received by the following public and free libraries:

CALIFORNIA
Los Angeles Public Library
San Diego Public Library

COLORADO
Denver Public Library

CONNECTICUT
Hartford Public Library

DELAWARE
Wilmington Institute Free Library, Wilmington

MARYLAND
Enoch Pratt Free Library, Baltimore

MASSACHUSETTS
Boston Public Library

MICHIGAN
Detroit Public Library

MINNESOTA
Minneapolis Public Library
James Jerome Hill Reference Library, St. Paul

MISSOURI
Kansas City Public Library
St. Louis Public Library

NEW JERSEY
Trenton Public Library

NEW YORK
Brooklyn Public Library
Buffalo and Erie County Public Library
Rochester Public Library
New York Public Library

OHIO
Akron Public Library
Cincinnati Public Library
Cleveland Public Library
Dayton Public Library
Toledo Public Library

OKLAHOMA
Oklahoma County Libraries, Oklahoma City

TENNESSEE
Cossitt-Goodwin Libraries, Memphis

TEXAS
Dallas Public Library
Fort Worth Public Library

WASHINGTON
Seattle Public Library

WISCONSIN
Milwaukee Public Library

An extensive collection of NASA and NASA-sponsored documents and aerospace publications available to the public for reference purposes is maintained by the American Institute of Aeronautics and Astronautics, Technical Information Service, 750 Third Avenue, New York, New York, 10017.

EUROPEAN

An extensive collection of NASA and NASA-sponsored publications is maintained by the National Lending Library for Science and Technology, Boston Spa, Yorkshire, England. By virtue of arrangements other than with NASA, the National Lending Library also has available many of the non-NASA publications cited in *STAR*. European requesters may purchase facsimile copy or microfiche of NASA and NASA-sponsored documents, those identified by both the symbols "#" and "*", from: ESRO/ELDO Space Documentation Service, European Space Research Organization, 114, av de Neuilly, 92-Neuilly-sur-Seine, France.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D. C. 20546
OFFICIAL BUSINESS

FIRST CLASS MAIL

POSTAGE AND F
NATIONAL AERONA
SPACE ADMINIST

012 001 STAR 710701 S01386
DUKE UNIV LIBRARY
PUBLIC DOCUMENTS DIV
ATTN: DOCUMENTS LIBN
DURHAM NC 27706

POSTMASTER: If Undeliverable (
Postal Manual) D

NEW NASA PUBLICATIONS

Seals and Sealing Techniques (NASA SP-5905(02))

A Technology Utilization Compilation of NASA and AEC descriptions—illustrated and in summary form—of a group of selected seals and sealing techniques believed to be both useful and practical, and hence of particular interest to a variety of industries in solving sealing problems. *Paperbound.* 20 pp. Available from the National Technical Information Service, Springfield, Va. 22151, for $1.00.

A Search for Carbon and Its Compounds in Lunar Samples from Mare Tranquillitatis (NASA SP-257)

Edited by KEITH A. KVENVOLDEN and CYRIL PONNAMPERUMA

This report describes the method of analysis and assembles information obtained during a comprehensive organic analysis of lunar materials from Mare Tranquillitatis by a consortium of investigators at Ames Research Center. The samples studied were obtained during the Apollo 11 mission, and were distributed to the scientific community by the Lunar Receiving Laboratory. On October 6, 1969, this comprehensive analysis began on Sample 10086 Bulk A Fines, comprising 100.5 g of fine-grained (<1 mm) black lunar fines. *Paperbound.* 128 pp. Available from the National Technical Information Service, Springfield, Va. 22151, for $3.00.

Scientific and Technical Information Office
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Washington, D. C. 20546